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I.

MORPHOLOGY AND EMBRYOLOGY OF THE NASAL
FOSSAE OF VERTEBRATES.*

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INTRODUCTION.

The nasal fossæ are hollow cavities in the facial bones, of varying importance, depending upon whether the animal is water-breathing or air-breathing; in the first group they serve exclusively as organs of olfaction, in the second they constitute, in addition, special canals through which the inspired air passes in order to reach the pharynx and the bronchial tubes.

*This translation is made with the approval of Professor Dieulafé, and with the kind consent of M. Felix Alcan, publisher of the *Journal de l'Anatomie et de la Physiologie Normales et Pathologiques de l'Homme et des Animaux*. The translator feels that the high merit of Prof. Dieulafé's monograph and the absence of a similar work in English justify the effort here made to extend its sphere of usefulness.

The nasal organ is constant in all species of vertebrates; single in *Amphioxus* and cyclostomes, double in all other classes. Its development is in proportion to the acuteness of the sense of smell in the lower, water-breathing vertebrates; it is independent of this in air-breathing vertebrates, and in them it is very complex and greatly extended by reason of the influence of the respiratory area. The Amphibia constitute an intermediate form between these two groups, which is of great interest.

The necessity for active respiratory combustion entails a greater amplitude of the nasal fossæ in warm-blooded animals, while their extension is proportionately less in cold-blooded animals. A single anatomic characteristic is sufficient to show this difference: the posterior nares of amphibians and reptiles open into the buccal cavity, but into the pharyngeal cavity in birds and mammals. In the latter, the air passes more directly into the respiratory tract and its renewal is therefore easier of accomplishment. In measure as we advance in the scale of vertebrates, we may observe complexities of structure designed to purify and to warm the air (promoted by the ciliated mucosa and the rich vascularity). Two factors are responsible for this action, the turbinates and the sinuses. The venous plexuses produce the great vascularity. In the course of these transformations, the olfactory region is more deeply placed, where it is protected against the grosser impressions and reserved for the more specific.

Olfaction is the perception of odorous particles carried by the atmosphere which surrounds us, these particles being held in suspension in the air which comes in contact with the olfactory surface. The sense of olfaction, such as we know it, conveys to our minds an idea of the penetration of gas or vapor; but a mechanical action, a current of air, is necessary in order to bring it in contact with the nasal mucosa. Bernstein remarks that olfaction is the sense which has the greatest acuity. Toulouse and Vaschide (1899) measured the olfactory power with camphor water, testing their subjects with a series of solutions of 1 to 10,000, 1 to 100,000, and 1 to 10,000,000. The subject's eyes were bandaged and the solutions were presented to him successively, beginning with the weakest. The writers determined that olfaction was more acute in women than in men, and in girls than in boys. They also made a study of olfactory fatigue and demonstrated the great

resistance of this sense, which was explained mainly by the simplicity of the perceptive apparatus.

The transportation of odorous particles by a gaseous medium is so necessary to our olfactory function, that it is difficult to recognize it in a liquid medium, which accounts for the doubts entertained as to the olfaction of fish. In man it seems probable that olfaction in a liquid medium is impossible. Weber demonstrated this in the following fashion: He filled his nose completely with cologne water (this experiment may be repeated without danger by lying in a horizontal position and allowing the head to hang downward vertically; the palate is thus raised, and water introduced into the nose cannot escape); as long as the water remained in the nasal cavity Weber could not perceive any odor, although he observed it perfectly at the time of the introduction of the water.

In aquatic animals, however, olfactory sensation may be of a different character, otherwise we should be compelled to deny the possibility of olfaction in fish. They have, at the disposal of this sense, a special apparatus, varying in its complexity with the different species, according as the corresponding nervous system (olfactory nerve and lobe) is developed. Geoffroy Saint-Hilaire speaks of the olfactory branchiæ, and we may foresee in this single term the explanation which this author gives: The olfactory branchiæ, like the respiratory branchiæ, extract the air from the water and this air disengages the odorous particles dissolved in it. Carus, on the contrary, does not accord to fish any great olfactory power. The strongest gas, such as ammonia or chlorin, makes no impression on the olfaction of fish, while frogs are greatly affected by this same gas. According to this writer, the sense which guides fish towards prey should be called scent. Bernstein compares the olfaction of aquatic animals to the phenomena of gustation. Blaue bases this same opinion upon his histologic researches, and demonstrates olfactory buds analogous to taste buds in a large number of fish. Duméril bases his opinion on the testimony of sailors and upon the results given in fishing with certain kinds of bait, and reports the arguments made by Cloquet to show the olfactory sense of fish: "Sailors state that when the blacks and whites bathe together in places frequented by sharks, the blacks, whose odorous emanations are more powerful than those of the whites, are more exposed than the whites to the attacks of these terrors of the seas."

Lacépède admits a most delicate olfactory susceptibility in fish.

It is, above all, in air-breathing animals that we find the olfactory sense least developed (birds, dolphins). The ancients were unanimous in claiming that birds had a very remarkable acuity and certainty of olfaction. They even cited the fable of the crows and vultures flying from Africa and Asia to Europe after the battle of Pharsalia. In modern times it is claimed, on the contrary, that birds are poorly endowed with this power. Buffon and Cuvier report that hawks seize upon their prey when it is struck and before it exhales any odor, while a few leaves thrown over it are sufficient to protect it from their attack. Milne Edwards has made some experiments in the Museum of Natural History. He placed, in a cage of vultures, a box covered by a curtain. This was torn at different times, until the birds became accustomed to the object and paid no attention to it. He then introduced into this box, covered in this simple way, some food with a strong nauseous odor, without the birds noticing it. When they were deprived of their customary nourishment they were bewildered, but made no attempt to attack the box. It is sight that plays the chief role in all birds of prey.

Toussenel (1873) says that the birds have no smell, just as they have no taste. It is not necessary, in animals which are to eat many things and to like everything they eat, that there should be a watchful sentinel before the stomach which would bring difficulty in the way of acquiring nourishment.

Raspail (1899) made, very recently, a series of observations concerning the sense of olfaction in birds. He noticed pheasants, partridges and wood pigeons leaving their usual bait when the wind carried towards them odorous effluvia betraying a concealed enemy. These birds discovered, by means of olfaction, an invisible vessel of water, the situation of which was often changed. The odor of a piece of Swiss cheese makes it possible to capture a titmouse. The titmouse, the crow and the magpie descend from great heights in search of worms buried in the ground.

The opinions of observers differ, but none is of any absolute value. In reality, the olfactory power of birds exists, but it is very feeble.

In cetaceans, the nasal fossæ are without any olfactory region and moreover the olfactory nerve is very much reduced or absent. However, Cuvier has observed an organ of olfac-

tion in the dolphin and in the porpoise. Whales have olfactory sensations. In fact, Lacépède reports that Pleville le Peley has seen whales leave a boat which contained decaying codfish. The property of secreting spermaceti has been attributed to these nasal fossae without sensorial role, or to the sinuses. Pouchet and Beauregard have observed that, in the cachelot, this substance is deposited in the recesses independent of the nasal cavities and their adnexa.

Besides these animals with a more rudimentary olfactory sense, mammals present varying degrees of olfactory power. They are divided into osmatics and anosmatics, depending upon the acuity of this faculty.

Distinct anatomic differences do not exist between these groups, carnivorous animals (macrosmatic) and the ruminants (microsmatic); there exists, however, some variation in structure.

The olfactory region occupies a greater or less extent of the nasal cavity and its relation to the respiratory region is very variable. My aim is to establish the respective value of the nasal organ upon anatomic and embryologic observations, and it is only by a study made upon the entire series of vertebrates that we can arrive at conclusive results. The anatomic literature abounds in works relative to the nasal fossae and this has furnished me numerous references.

In my study I have been occupied only with the nasal cavity and its adnexa, leaving out entirely the description of the corresponding nervous system. I have divided this into three chapters: I, Morphology, II, Embryology, III, General Considerations. In the final résumé, I report only the facts which have a value from the standpoint of comparative study.

I have carried on the greater part of my investigations in the Laboratory of Zoology of the Faculty of Science at Toulouse, where I have found extensive material for study.

In so far as embryology is concerned, I have been enabled to make numerous observations upon the rich and priceless collection in the laboratory of histology of the Faculty of Medicine at Toulouse. In the course of my work I have received numerous favors from Profs. Charpy, Moquin-Tandon, Tourneux and Dr. Jammes, Head of the Conference of Zoology, and Dr. Soulie, Professor Agrégé of Anatomy. I thank them for their advice and for their invaluable suggestions, for their generous hospitality, and I assure them of my gratitude and devotion.

Prof. Giard, Member of the Institute, has had the kindness to furnish me with suggestions and I express to him my deepest gratitude.

My friend, Dr. Mandoul, Preparateur of Zoology, has facilitated my task by procuring for me a large amount of material; I thank him sincerely.

I am very grateful to Messieurs Roques and Durand and to Dr. Soule for kindnesses which they have shown in the execution of the figures which accompany the text.

MATERIALS FOR STUDY.

For the anatomic portion, I have had recourse to dissections and microscopic sections imbedded in paraffin. I have followed, several times, the procedure of Retterer (1903) (imbedding in vacuum at 40 degrees). For embryologic study I have used serial sections after fixation in Kleinenberg's fluid.

The adult specimens were decalcified by the procedure of Morel and Soulié (formic acid 1-5), stained en masse with alum carmine.

My studies have been carried on with the following animals:

I. MORPHOLOGY—*Cyclostomes*: Petromyzon, Ammocetes. *Selachians*: Scyllium, Acanthias, Raja. *Teleosts*: Barbel, Gurnard, Trout, Eel, Cod. *Ganoids*: Sturgeon. *Amphibians*: Toad, Frog, Triton, Axolotl. *Reptiles*: Adder, Viper, Blindworm, Python, Boa, Galeote, Crocodile. *Birds*: Pigeon, Duck, Turkey, Vulture. *Mammals*: Complete series of bone specimens; Guinea Pig, Mouse, Rat, Badger, Sheep, Cat, Dog, Monkey, Man.

II. EMBRYOLOGY—*Cyclostomes*: Petromyzon planeri of 4 and 6 mm. *Selachians*: Pristiurus melanostomus of 3 to 22 mm. and Scyllium canicula, 30 millimeters. *Teleosts*: Salmon Trout 22nd day of development and 30 days after hatching, and Rainbow Trout, 30 and 60 days after hatching. *Amphibians*: Toad and Frog, larva of 4 mm. *Reptiles*: Adder of 4 cm., Blindworm, 25 mm. to 7 cm., Viper 4 cm. *Birds*: Undulated Parrot of 5 to 23 mm., Duck 4th to 12th day of incubation. *Mammals*: Guinea pig 5 to 14 mm., Sheep 8 to 25 mm., Mole 4 to 17 mm., Human Embryos 8 to 16 mm., 23.5 cm. The first stages of the undulated parrot and of the sheep, the complete series of the mole and human embryos have been studied in Prof. Tourneux' collection.)

CHAPTER I.

MORPHOLOGY.

AMPHIOXUS.

Koelliker described, in 1843, the olfactory organ of *Amphioxus*. This very rudimentary organ is formed by a single involution which is attached to the nervous system by its sharp inferior extremity.

This shallow, cupuliform depression is situated on the left side of the head, in front of the left eye, and is separated from it by the most anterior nerve trunk.

This organ is not united to the buccal cavity. It consists of an external cartilaginous envelope and a mucosa with a ciliated epithelium. The presence of cilia is the most characteristic sign that causes us to think that the fossa is really the olfactory organ.

De Quatrefages (1845) described the same fossa with all the characteristics noted by Koelliker.

Paul Langerhans (1876) found in the epithelium, which lined the fossa, two kinds of cells, one tall, narrow and cylindrical, each one provided with a long cilium. The others also have cilia, but are distinguished from the first by the smallness of their bodies and the largeness of their nuclei. These elements are easily separable into small groups and may be regarded as true olfactory cells, and their cilia as sensory cilia.

FISH.

I. CYCLOSTOMES.

The cyclostomes belong to the *Monorrhina*. They have a single olfactory organ placed in the median line, which opens on the dorsal surface of the head.

ORIFICE.—The orifice is round, narrow, usually terminating in a small tube which projects 1 to 2 mm. above the integument. Its situation corresponds to the blow-hole of the dolphins, so one must admit that there exist *Monorrhina*

among the Mammalia. But here the Monorrhina is characterized not only by a single nasal opening, but also by a single nasal sac.

Vogt and Yung (1894) described, in these folds, a fibrous thickening of the subcutaneous tissue, and in the interior of the tube, close to where the entrance opens into the sac, a very peculiar valvular apparatus analogous to those of the cardiac arteries. This tube, or more correctly the folds that enclose it, is detached from the rest of the integument at the bottom of a depression, in such a way that the tube projects above the dorsal surface less than its entire height, and is surrounded by a circular, uninterrupted groove. While in *Petromyzon*, the tube is narrower at its extremity than at its base, in *Ammocoetes* it widens exteriorly into a funnel.

It extends from above downwards and from before backwards, and leads into the nasal sac, its base being lost in the walls of the latter.

NASAL CAVITY.—The dimensions of the nasal cavity are not great. It is situated at a considerable distance behind the tip of the snout, immediately in front of the brain, above the digestive tube, from which it is separated by a very thick mass of muscle in *Ammocoetes*, while in *Petromyzon* there is only a cartilaginous septum between the two organs. Its position is well shown by a sagittal section of *Petromyzon* (Fig. 1).

The interior of the nasal cavity is occupied by lamellae which cause folds of the mucosa. In *Petromyzon*, the lamellae are arranged around all the walls in such a way that they converge towards the center. They are thick and very slightly elevated. Langerhans, Vogt and Yung observed a median, vertical lamella which divided the cavity into two symmetrical halves, and these correspond to the nasal fossae of more highly organized animals. We have never found anything similar in *Petromyzon*, and Pogojeff never observed any trace of this relation. It was different, however, in *Ammocoetes*. In a transverse section passing through the middle of the nasal cavity (Fig. 2), a long thick lamella can be seen running vertically downward from the dorsal wall nearly to the floor, and in the exact median line.

On each side is found a fold of the ventral wall forming an ascending lamella which is almost vertical and concave on its internal aspect.

Between the lamellae, in *Petromyzon*, is a star-shaped cavity, of considerable size in comparison with the nasal sac. In *Ammonoetes*, there are only stellate fissures.

An axis of connective tissue extends into the interior of each lamella. This is condensed at the periphery and forms a layer separating the mucosa from the cartilaginous sac. In the connective tissue, in *Petromyzon*, there are numerous pigment cells, which give a dark color to the nasal organ.

CAPSULE.—The cartilaginous capsule completely surrounds the olfactory apparatus. It is open at its anterior pole to communicate with the entrance tube. Behind, it is perforated to give passage to the olfactory nerves. Furthermore it is in relation with the naso-palatine tube, a kind of diverticulum from

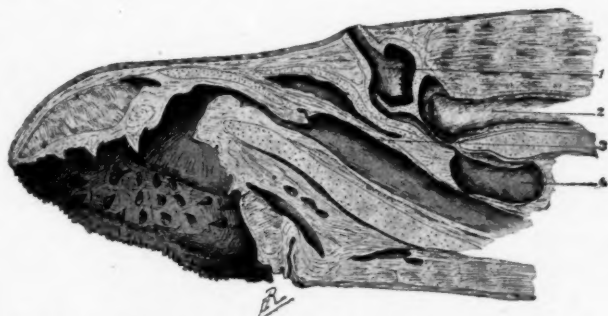


Fig. 1. Half natural size. *Petromyzon planeri* (Sagittal section).
1. Nasal cavity; 2. Central nervous system; 3. Digestive tube;
4. Naso-palatine canal terminating in an ampullar cul-de-sac.

the ventral wall, which is directed downwards towards the digestive tube but does not reach it. As our sagittal section (Fig. 1) shows, this canal arises at the anterior part of the nasal sac, and runs obliquely backwards and downwards, and ends in a large cul-de-sac, which lies below the cranial cartilaginous capsule and above the digestive tube. Its posterior wall is in relation with the branchial laminae. In *Myxine*, the writers describe the communication of this canal with the buccal cavity, which brings the cyclostomes close to the vertebrates in aerial respiration, and this finding is favorable to the hypothesis that the cyclostomes are vertebrates that have degenerated under the influence of a parasitic life.

The extent of the cartilaginous capsule can be easily seen in sections or upon dissection.

While completely isolated in *Ammocoetes* and separated from the neighboring organs by connective or muscular tissue, in *Petromyzon* it is in intimate relationship with the cranial capsule and fuses with its anterior wall; at this level a simple partition separates the olfactory organs from the brain. The filaments of the olfactory nerve are very short as the result of the topographic relations of these two organs. In the interesting horizontal sections of the nasal cavity and nervous

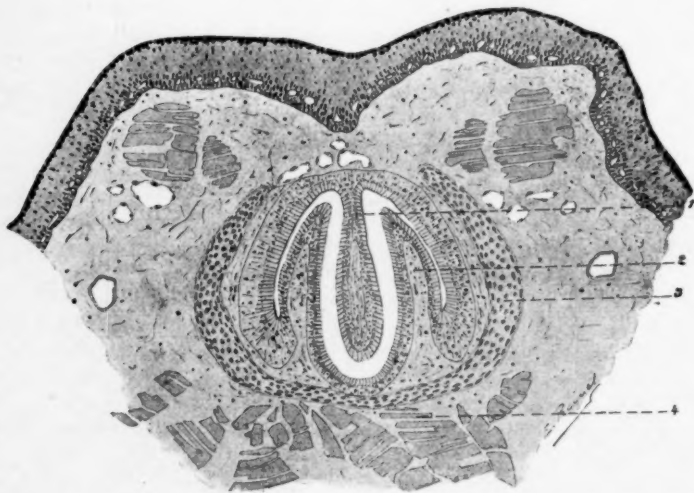


Fig. 2—X 70. *Ammocoetes* (transverse section passing through the nasal cavity). 1. Median dorsal lamella; 2. Ventral lamella; 3. Cartilaginous capsule; 4. Muscular portion.

system, two series of olfactory filaments (Fig. 3) are to be seen, between these two structures. They arise from the anterior wall of the brain, on each side, from the interhemispheric fissure and meet at the bottom of the nasal cavity; the different branches are distributed to the two symmetrical regions, posteriorly convex, which are placed on either side of a median lamella. On the ventral side, a layer of connective tissue

separates the capsule from the cartilaginous roof of the digestive tube.

GLANDS.—The olfactory apparatus of the cyclostomes is distinguished from that of other animals with aquatic respiration by the presence of glands. They are situated, according to Pogojeff (1888), Vogt and Yung, at the bottom of the organ, in the segment which is limited to the olfactory bulb; they penetrate into the cartilaginous tissue and are surrounded by nerve fibres. The cellular elements of these glands described by Pojogeff are formed of two kinds of goblet cells;

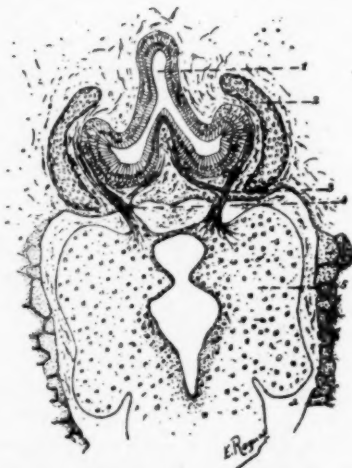


Fig. 3—X 70. Ammocoetes (transverse section showing the nasal cavity and two olfactory nerves). 1. Nasal cavity; 2. Cartilaginous capsule; 3 and 4. Olfactory nerves; 5. Brain.

one is very long, very contracted and provided at its lower extremity with a long, very thick prolongation; towards the superior extremity there is a striated area, while the nucleus lies in the middle of the cell. The other cells are larger with a round base containing the nucleus. We have not found this glandular apparatus in Ammocoetes.

Scott found in a larva of *Petromyzon*, $12\frac{1}{2}$ mm. long, in the posterior part of the nasal cavity, a diverticulum whose place in the adult is taken by the gland we have just described.

He considers this formation to represent the organ of Jacobson, in which opinion Bujour concurs.

There can be no question of such an organ in these animals. The independence of the nasal apparatus and the buccal cavity is sufficient to explain its uselessness and its existence only adds to the regressive characters which connect the cyclostomes with air-breathing vertebrates.

MUCOSA.—Retzius (1880), in *Myxine*, found a cylindrical epithelium without nervous terminations at the free, anterior border of the folds and at the posterior fixed border, as well as in the furrows between them. On the surfaces of the folds, turned towards each other, the epithelium which is, on the contrary, much taller, is the olfactory epithelium.

In *Petromyzon*, a similar distribution is found in the topography of the nasal epithelium. The true olfactory epithelium shows two fundamental cellular forms. The first consists of long processes which extend the entire height of the olfactory epithelium, in the middle third of which the nucleus is found. The protoplasm is entirely clear with hardly a granule. The superior extremity is covered with a finely granular border from which delicate, wavy cilia extend. The inferior extremity of the cells is very often enlarged. In the other cellular form, the body is shorter, pea-shaped and the nucleus is very much higher. The superior extremity is thin and the inferior extremity does not reach the deepest layer of epithelial cells, and encloses the nucleus. The substance is clear, but distinctly granular. The delicate inferior prolongation extends to the connective tissue, but Retzius was not able to find its communication with the nerve fibres.

Pogojeff (1888) found in *Petromyzon* a flattened epithelium at the edge of the free border of the folds, as well as in the depressions which limited them. These cells are large and slightly elevated and are provided with cilia.

Upon the lateral surfaces two series of cells are found, which are made manifest by two series of nuclei placed at different heights. Some are cylindrical, in the form of goblet cells; others are conical, with an enlarged superior extremity and an inferior extremity pointed and bent inward. These are the supporting cells. The second variety of cells merits the name of neuro-epithelium. They are round and fusiform, terminating inferiorly in a varicose prolongation, and their superior extremity forms a sort of cap. Furthermore, they are

as small as the first, are almost cylindrical and are narrowed towards the extremity, from which a nerve prolongation arises.

In *Ammocoetes*, we have found in the whole extent of the nasal cavity, as well as in their intervening folds, delicate, greatly elongated, cylindrical cells, which present a clear and homogenous central portion and a peripheral portion containing the nucleus and highly colored protoplasm. Between the peripheral prolongations of the cells, there are found irregular elements, some rounded and some slightly elongated. The epithelium upon the dorsal lamella measures 36 mikra in thickness; upon the ventral lamella, 26. The cells throughout the mucosa have an average height of 14 mikra (Fig. 2).



Fig. 4. Half natural size.—*Scyllium catulus* (ventral surface of the head, showing the valve of the anterior border of the nasal orifice). 1. External part of nasal orifice; 2. Valve of the anterior border; 3. Buccal orifice.

II. SELACHIANS.

We will commence the series of *Amphirhina* with the selachians; they are distinguished from the other animals of this large group by the ventral position of the nasal orifices.

ORIFICE.—For each nasal cavity there is only one orifice. In *Scyllium catulus* the nasal cavities are very far from one another. This peculiarity distinguishes it from *Scyllium canicula*, where they are contiguous in the median line. Each

nasal orifice or naris is a very wide, transverse cleft placed in front of the buccal orifice. A large, high valve, a prolongation of the anterior or superior border, covers the greater portion of this slit (Fig. 4), only the external region being free; it has the form of a circular opening. This region is accessible to the current only from the front. On lifting the valve, the entire extent of the opening is visible, but it is divided into two regions by a tubular prolongation, which extends forward from the posterior or inferior border.

On examining the naris from its internal instead of its external face, after the nasal cavity has been opened wide, it is seen that the prolongation from the posterior border represents a kind of a valve which masks the external part of the orifice (Fig. 5). Seen from this side, the latter is freely opened in its inner two-thirds and has the form of a funnel. This internal part of the orifice favors the exit of the current of water.

To sum up, two incomplete valves are opposed to one another. The portion of the orifice which is not covered by the anterior valve is open outward. This is the orifice of entrance. The part which the posterior valve leaves free has a wide opening internally which is the orifice of exit. This valvular apparatus forms a double orifice, from a functional standpoint.

In *Raja batis*, the anterior valve is arranged as in *Scyllium*, while the posterior valve does not exist.

Lacépède (1867) ascribes to these animals the power of completely closing their nasal orifices by means of the valve, and of being able to close the olfactory apparatus, under certain circumstances, to useless or very intense sensations. He compares this valve to an eyelid.

CAVITY.—The cavity has an almost elliptical form and is occupied by lamellae arranged in two long rows with a transverse axis, and inserted in the roof of the nose in such a way that they run vertically downward. The inferior border is free, the external border is bound to the wall by a little, delicate, non-resistant tract. Their height is from 18 to 20 mm. and their transverse extent from 5 to 6 mm.

The nasal cavity is bounded by a connective tissue partition which contains numerous pigment cells. Surrounding it is a cartilaginous capsule analogous to those which surround the eye, ear and brain.

This very simple capsule moulds itself around the nasal sac. Behind, it is in relation with the olfactory bulb, the filaments of which penetrate it in order to enter the nasal sac.

Within the cavity, the mucosa presents numerous folds inserted at the level of the roof and lateral walls; the highest are situated at the middle of the dorsal wall. They are composed of a connective tissue axis containing blood vessels,

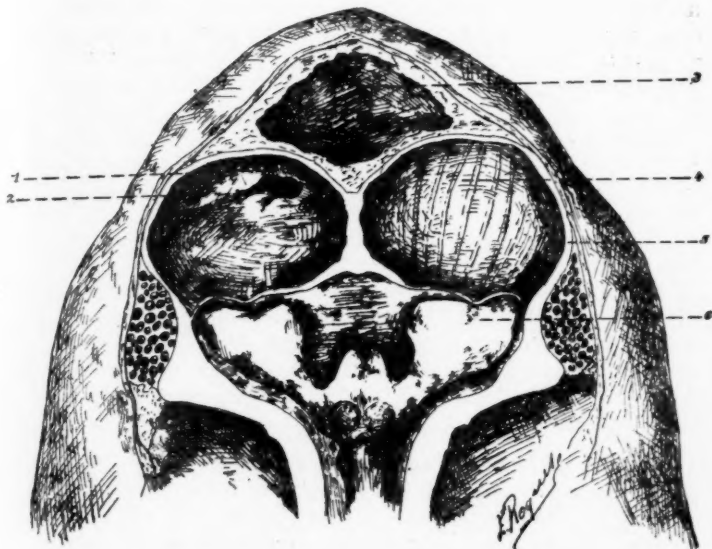


Fig. 5. Five-eighths natural size. *Scyllium catulus* (both nasal cavities and the cranial cavity are opened on their dorsal surface. On the right, the olfactory sac; on the left, nasal cavity with contents, showing on the floor the internal part of the nasal orifice and the valve inserted on the posterior border of that orifice). 1. Valve of the posterior border; 2. Internal portion of the nasal orifice; 3. Cavity containing mucous tissue; 4. Olfactory sac; 5. Cartilaginous capsule; 6. Olfactory bulb.

covered with an epithelium which is uniform in structure and formed of cylindrical cells.

Blaue (1884) did not find among the plagiostomes the olfactory buds which he describes in a large number of teleosts. As Leydig and Max Schultze have already shown,

there is no particular region for the olfactory epithelium; it is spread out over the folds of the mucosa, but does not reach their free border and is especially abundant in the intermediate grooves.

The olfactory epithelium, according to Max Schultze, covers bands which reveal themselves in the mucous folds; it consists of ciliated cylindrical cells which have a long basal prolongation, of fusiform olfactory cells with a basal segment containing the nucleus and provided with two prolongations, and of replacing cells which are attached to the underlying tissue by a series of fine denticulations. Between the flattened feet of these cells lie stellate connective tissue cells, which form the most superficial layer of the membrana propria.

Koelliker assigned a nervous function to this epithelial layer, but Max Schultze does not agree with this; he finds that the finer branches of the olfactory nerve enter into the epithelium.

III. TELEOSTS.

These form the second group of Amphirrhina. Their nasal apparatus shows certain common, primordial characters, with considerable variation in detail. The latter are mentioned in works dealing with their classification.

ORIFICES.—The nasal cavity is entered by one orifice, or by two orifices both of which open externally. An exception is described by Wiedersheim (1890) among the Dipnoa (*Protopterus*) where there are two nasal orifices, one situated near the upper lip, the other much further back. The nasal organ has no direct communication exteriorly, but opens into the buccal cavity. In other fishes, the orifices show certain differences in form and position. The anterior orifice is sometimes pierced at the level of the skin by a posterior lip prolonged as a tentacle (*Gadus*, *Mustelus*), and sometimes it reaches the extremity by a tubular prolongation (conger, gurnard and eel).

The posterior orifice always opens on the surface of the skin, is usually elliptical, but in the gurnard it is a simple slit. It is joined to the anterior orifice in the barbel; it might be said that a single orifice is converted into two by an antero-posterior bridge. The anterior orifice, which at the same time

is the internal, has a sort of valve covering it formed by simple prolongations of its internal border. This valve prevents the entrance of water into the nasal cavity but allows its exit. The tube or tentacle, which is found in a large number of species, is said to play the same role. The posterior orifice is used for the entrance and the anterior orifice for the exit of the current.

CAVITY.—The nasal cavity is a very simple sac. If the dorsal wall in the barbel or the gurnard is lifted, a large number of folds will be found extending into the cavity and in a measure occupying it. These folds resemble rays disposed around a central lumen. They are inserted at the bottom and periphery of the nasal sac, and all have the same dimensions. Between their free borders, the nasal lumen has the form of a cup, and from its center it radiates between their surfaces.

The olfactory nerve enters the nasal sac from below, about the middle, and from there it is distributed to the lamellae.

In the eel, there is a different disposition of the lamellae; they are placed on each side of a longitudinal axis, parallel to each other, and are inserted into the floor of the cavity (Fig. 6). They have a quadrangular form, narrow in front, prolonged into a cylindrical tentacle towards the anterior orifice, and extend beyond the end of the nose. The large, round, posterior extremity shows the posterior orifice at its external angle.

A transverse section of the head of the eel (Fig. 6) shows the insertion of the lamellae along the floor, and the contour of the nasal sac, formed by a connective tissue sheath. This is usually pigmented, black or brown, which makes the nasal sac easy of recognition in dissection. As they are placed near the dorsal aspect, the nasal organs are completely independent of the buccal cavity, from which they are separated by a bony wall. A vertical bony septum separates them from each other in the median line. The bones are never in direct contact with the nasal sac, being separated from it by a considerable amount of connective tissue.

SKELETON.—The skeleton is formed by a series of facial bones which are arranged not so as to define a bony nasal cavity, but to form an irregular interspace in which the fibrous nasal sac is situated without any adaptation of form. We have studied this nasal skeleton in the cod, where there is a superior wall

formed by the middle ethmoid and the nasal bone, an external wall formed by the anterior frontal, and an inferior wall formed by the vomer and the lateral ethmoid (Fig. 7).

Nasal Bone.—A paired, flattened bone, larger behind than in front, with rectilinear internal and external borders. The posterior extremity shows a groove. Longitudinal undulations of the superior surface form a projection along each border with a groove in the middle. The inferior surface is concave in its external portion, projecting in its internal. It is articulated in front with the maxillary bone and, external to this extremity, with the anterior frontal; behind with the frontal, internally (posterior third) with the median ethmoid.



Fig. 6—X 40. Eel (transverse section of the nasal cavity passing through the posterior orifice). 1. Posterior nasal orifice; 2. Lamellae.

Frontal Bone.—Single bone, large, squamous, bifid anteriorly, each half corresponding to one nasal bone. It is only by this anterior extremity that this bone enters into the formation of the nasal skeleton. At the angle formed by these two points, it articulates with the middle ethmoid and, by lamellae derived from its inferior surface, with the lateral ethmoids.

The Middle Ethmoid.—Single bone, presenting a large anterior part and a thin, tapering posterior part. The anterior part is thick and curved at a right angle, so as to present a horizontal and a vertical segment. Some lamellae derived from

the borders of this bone are directed backwards and outwards, forming together an inverted funnel. The middle part of this bone is prolonged backward to form a posterior part which tapers out, articulating with the lamellae of the frontal bone. The anterior part is united along the median line with the vomer and laterally with the lateral ethmoids.

Lateral Ethmoid.—Paired bone, irregular, with a very thick massive body from which wing-like lamellar prolongations extend on all sides.

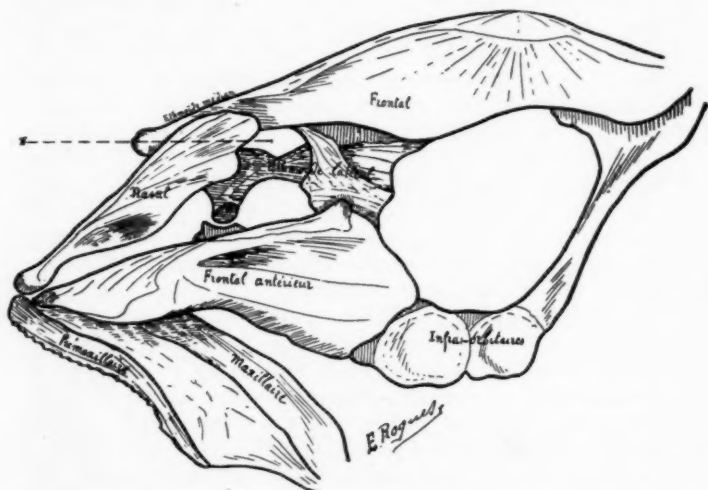


Fig. 7. Half natural size. Cod (external view of the head showing the bone surrounding the nasal region). 1. Space for the nasal sac.

Anterior Frontal or Prefrontal Bone.—This is a bone of large size, very long, flat, of triangular form, with its anterior apex joined to the premaxillary bone, with its posterior base united internally with the lateral ethmoid, and externally with the infraorbital. Its internal border is at some distance from the nasal and frontal. There exists between them a large interspace which in the fresh state is filled by a fibrous membrane. This membrane is pierced by the orifices of the nasal sac.

Vomer.—Single bone with an anterior enlarged portion which zoologists call chevron (Moreau) and a long posterior prolongation. The inferior face of the vomer, in the place corresponding to the edge of the chevron, is provided with teeth; behind it is smooth. The vomer is united in front with the two maxillary bones, with the palatal bones by the projections of the chevron; above with the ethmoids; below it is free and forms part of the palatal vault.

The names given above are taken from the nomenclature of Cuvier and Agassiz.

The osseous part of the cranium is subject to variations of one kind or another, and we were not able to make a detailed study. Sagemehl (1885) made an extended study of the crania in the Characinidae. His nomenclature is very similar to that which we have given for the cod. The prefrontal forms the posterior limit of the nasal region and contains two canals, which run from the orbit to the nasal fossa. The inferior orifice gives passage to the olfactory nerves and the superior to a branch of the trigeminus. The middle and inferior boundaries of the nasal apparatus are formed by a part of the primordial cranium which has remained cartilaginous; the inferior part of the septum is formed by the vomer which behind is united with the parasphenoid. The roof of the cavity is formed by the nasal bone. In the work of Swinerton (1902) upon the development of the cranium of the teleosts, we find plates showing *Gasterosteus aculeatus* with the bones of the nasal region similar to those which we have described and designated.

NASAL SAC.—The connective tissue which surrounds the nasal cavities is condensed into a fibrous membrane and forms a complete envelope broken only at the level of the nasal orifices. This wall is delicate, of little resistance and contains a considerable deposit of pigment. The deep layers are formed by a looser connective tissue which deep down is directed toward the cavity and acts as a support for the lamellae of the mucosa. It contains vessels and nerves.

MUCOSA.—Schultze, Grimm, Blaue, Sophie Pereyaslawzeff and Dogiel have studied the structure of the olfactory mucosa. Two kinds of cells have been found; one epithelial (supporting cells), and the other neuroepithelial (olfactory cells). Dogiel (1887) described the supporting cells of the ganoids as very fine membranous formations which seem concave be-

cause they are adjusted to the convexity of the adjacent olfactory cells. Their staining reaction is similar to that of mucous cells. He found three kinds of elements among the olfactory cells: The first is the olfactory cell of Schultze, which is very delicate, with central extremity thickest and peripheral part appearing as a varicose prolongation in direct continuity with the primary fibril of the terminal roots of the olfactory nerve. The second has a cylindrical form, and the third is a thick structure in the form of a cone or cask.

The researches of Blaué (1884) were carried out upon a large number of species of fishes. He has found two kinds of animals. In some, the olfactory cells are grouped to form olfactory buds in every way analogous to the taste buds. These open upon the epithelial surface by pores which open into a small cup. The epithelial elements are long, extending from the basal connective tissue to the level of the tube. They are alternately supporting and sensory cells. Between the pores, the indifferent epithelium is composed of cells arranged in the form of overlapping cells. The most superficial are flattened; deeper down, they are polyhedral, cylindrical and, finally, fasciculated. The olfactory buds show a very variable distribution, sometimes spreading out over the entire lamella and the intermediate spaces (*Belone*), sometimes lying only in the intermediate spaces (*Trigla gurnardus*, *Exocetus volitans*, *Umbra caneri*, etc.). Sophie Pereyaslawzeff (1876) considers the olfactory bulbs to be groups of olfactory cells and does not mention supporting cells.

In another group of fishes (the eel, conger, the carp, tench, etc.) the olfactory epithelium is such as has been described by Leydig and Max Schultze. It extends over the entire lamella and generally, in the intermediate spaces, it is replaced by indifferent epithelium. Huot (1902) found in *Lophobranchia*, by the method of Golgi, that the olfactory cells were composed of a large, oval, basillar portion and a narrow prolongation, which extended toward the free surface of the epithelium. This prolongation slightly projects into the cavity and may be either simple or bifurcated.

In the eel and the trout, a homogenous epithelium extends over the lamellae and their interspaces. The cells are long, cylindrical, with a deep part containing a large oval nucleus, and a superficial part containing clear, finely granular protoplasm.

The dorsal and lateral walls of the nasal cavity are clothed

with a stratified epithelium. The deeper cells are rounded, the most superficial are elongated, but their height is irregular.

There are no traces of glands in the nasal mucosa.

Winther described in the salmon a canal which he considered the organ of Jacobson. It runs downward, is situated below the olfactory cavity and terminates in a cul-de-sac. According to Jungersen and Sagemehl, this is simply a mucous canal which extends transversely between the two nasal cavities during embryonic life, persisting through life in *Amia*. Wiedersheim admits the presence of an organ of Jacobson in *Polypterus bichir*, an opinion which is not shared by Waldschmidt (1887).

Garnault did not find the organ of Jacobson in the dipnoans, nor did Seydel in the teleosts. Even during embryologic developments, we have never found any diverticulum which could correspond to it.

IV. GANOIDS.

The sturgeon has two nasal orifices placed just in front of the eyes, one at the internal border of the dorsal aspect of the head and the other on the external. The first, which is the most internal and anterior, is circular. Its borders are rigid and distinct.

The other, which is external and posterior, has an elliptical form with a large vertical axis. Its borders are gradually lost in the neighboring parts. On the anterior border, a movable membrane is placed, which covers a large part of the orifice like a valve. This valve is to close the opening under the influence of an external force, and seems to prevent the entrance of water through the postero-internal opening, while permitting its exit. The antero-internal orifice has a large opening, is accessible to the exterior current and serves for a port of entry.

Between these two orifices is a cartilaginous bridge covered with a dermo-osseous plate running from above downward and from behind forward; it is very narrow (5 mm. in a specimen of 1 metre total length). The valve of the posterior orifice seems to enlarge it.

The walls of the nasal cavity are composed of thick, resistant cartilage; furthermore, the external, dorsal and internal walls are covered with a bony sheath.

After ablation of this bridge, lying between the two nasal cavities, a large recess gives entrance to the nasal cavity. This has the form of a semi-hemispherical capsule. In the center, there is a cylindrical axis from which runs numerous lamellae towards the borders of the cavity. These lamellae are largest near this axis, gradually decreasing as they approach the periphery.

We have not found the secondary lamellae noted by Moreau (1881). A long cartilaginous conduit placed within the orbital cavity extends obliquely from within outwards and from behind forward from the cranial cavity to the floor of the nasal capsule. It contains the olfactory nerve, a large cylindrical cord, which reaches, in this form, the axis of insertion of the lamellae and then divides into branches which are distributed throughout the whole organ.

The nasal cavity, as a whole, is situated in front of the eye, but in the same horizontal plane. It is very far in front of the cranial cavity, and separated from that of the opposite side by a distance of $2\frac{1}{2}$ cm. It is situated on a vertical plane considerably anterior to the buccal orifice.

AMPHIBIA.

The nasal cavities begin to assume the aerial type; a portion of the air in passing through them reaches the pulmonary apparatus. From now on, they occupy a double role, olfactory and respiratory, but the latter is still of slight importance.

ORIFICES.—In taking as a type the frog (*Rana esculenta*) or the toad (*Bufo vulgaris*), which presents the same conditions, we find the nasal cavities provided with two openings, one external, the other internal. The external dorsal orifice is situated upon the side of a median antero-posterior projection, and extends from the biocular line to the end of the snout, penetrated at the junction of its anterior and middle thirds by this projection. It is circular and limited by well-marked, rigid borders. These form a slight cushion in the external part of the orifice which, according to certain authors [Vogt and Yung (1894) Chatin (1880)] constitutes a short tentacle which closes the nose when the frog plunges into the water. The border is bony only on its inner side; otherwise it is composed of integument alone. The muscular fibres below the

skin have been studied in the frog, triton and salamander by numerous authors. Zenker, Duges, Klein, Ecker, Gaupp, Volkmann and Collan have described certain bundles, disposed around the external nasal orifice. Moreover, Henry Bruner (1902) published an extensive study of the mechanism of respiration in the Amphibia, with lengthy and minute descriptions of the nasal muscles. There is a dilator muscle and, in some species, one or two constrictor muscles..

The inner orifice, visible at the edge of the palatal vault, a short distance from the lip, is a little posterior to the external orifice. The air passing through the nasal cavity must go through a large part of the buccal cavity before reaching the respiratory passages. The nasal air passageway is still imperfect. The internal orifice is circular, wide open, surmounted within by a small round tubercle visible in the frog and absent in the toad. It is further from the median line than is the external orifice.

In the siren, Vaillant (1863) found that the internal orifice is quite anterior, in the gingivo-labial fold, at the level of the posterior part of the dental laminae. This is the result of the almost exclusively aquatic character of the animal.

CAVITY.—The cavity, possessing these two kinds of orifices, is simple with almost smooth walls. Upon removal of the superior wall, the cavity may be seen, rectangular in form, measuring, in a frog of average size, 5 millimeters in its antero-posterior diameter and 7 mm. in its transverse. At the level of the floor, there are a groove within and an antero-posterior ridge externally. The posterior part of the ridge is especially well marked; external to it is found the internal orifice. Irregular folds of the mucosa are observed at the antero-internal angle of the cavity. At the level of the folds, the color of the mucosa is darker than that of the rest of the nasal cavity, while at the level of the posterior part of the groove it is a spotted dark brown. The cavity is flattened in its dorso-ventral diameter; its vertical diameter is 2 millimeters.

The study of the nasal cavity by dissection is incomplete as the principal cavity, to be described, cannot be seen. It is only by transverse histologic sections that we can see all the details of the olfactory apparatus. We have always used formic acid for decalcification before subjecting the specimens to the various manipulations necessary for paraffin imbedding.

On a transverse section through the middle part of the cav-

ity, the main cavity may be seen communicating, at the external border of the floor, with a large hollow cavity in the facial bones, which has a large transverse diameter and is concave inferiorly. This accessory cavity presents an internal portion adjacent to the main part and an external portion, directed towards the side of the head, whose outlines (Fig. 10) are parallel with those of the head itself.

Transverse sections made anterior to the orifice of communication between these two cavities show the main cavity communicating extensively with an inferior diverticulum, while the accessory cavity is completely closed and diminishing in measure as it approaches the anterior border. Behind the zone of communication, the accessory cavity is modified; the lumen of its internal portion disappears, a large glandular mass taking its place. The external portion forms a diverticulum of the main cavity, extending backward to the level of the choana.

Posterior sections at the choana show only the main cavity with a very regularly elliptical form. We can study the general anatomic construction of the nasal apparatus better by transverse sections than in any other way.

CARTILAGINOUS SHEATH.—In a large part of its extent, the nasal cavity and its diverticula are surrounded by cartilaginous bands. In Fig. 10, we see a mass occupying the median line in the form of a septal partition from which the laminae extend externally. A lamina, prolonging the posterior border of the septum, forms the roof of the nasal cavity, and ends in the vicinity of the supero-external angle of this cavity. A middle lamina extends from the external border, in a slightly oblique direction inferiorly and externally, and then extends horizontally. It separates the nasal cavity from the adjacent diverticulum and borders internally the orifice of communication between the two cavities. Upon the same horizontal plane, another fragment of cartilage borders this orifice externally. An inferior lamina, continuing the inferior border of the septum externally and below, forms the floor of the inferior diverticulum and at the same time the framework of the roof of the mouth. At this place, the external wall and a portion of the roof of the nasal cavity are divested of their cartilaginous envelope, likewise the outer part of the inferior diverticulum. The appearance of this cartilaginous investment depends upon the particular transverse section considered. In the most anterior sections it is complete, and is moulded to the nasal

cavities. The inferior lamina is very large in the anterior portion of the nasal region and the inferior diverticulum is completely ensheathed. At the orifices, there is a sudden interruption in the cartilaginous wall, but the area divested of cartilage is larger in extent than the orifices themselves.

Behind, the cartilaginous sac has a large opening externally and inferiorly, so that the external diverticulum is free of cartilage in its entire periphery and a large portion of the buccal roof is formed of soft parts alone. It is in this zone that the choana opens.

Finally, behind this, the cartilaginous lamina of the buccal roof is once more of great size and the nasal cavity, single at this level, is once more completely encapsulated.

Born gives a lengthy description of the cartilaginous framework of the nasal fossae: "The nasal cavities are separated from one another by a septum of hyalin cartilage and at their anterior and posterior extremities are surrounded by two cartilaginous shells, extending from the septum, which are united to each other by a slight roof along the septum and by a floor complete in front and cut off by the choanae behind."

Ecker describes and depicts the cartilaginous framework of the cranium as constituted by laminae which fill up the interosseous spaces. His figures are views of the surface which show well the importance of this supporting tissue, which is indispensable for enclosing and protecting the cephalic organs contained in bony spaces with very incomplete walls. It is these bony walls which serve to support the cartilaginous skeleton.

BONY SKELETON.—In the nasal region, the bony limits anteriorly are the intermaxillary and the maxillary bones, internally the intermaxillary, behind the *os en ceinture* (frontoparietal) and the prefrontal and below the palate and vomer.

Intermaxillary.—Single bone, presenting a posterior part, flattened from above downward, situated in a horizontal plane, becoming more attenuated as the posterior end is approached, having a superior surface, with a median groove formed by two longitudinal ridges and an inferior concave surface. The anterior part of the bone is enlarged, is directed obliquely forward and downwards and presents a free border armed with teeth. It articulates behind with the *os en ceinture* and laterally with the superior maxillary bones.

Superior Maxillary.—Bilateral, elongated, flattened laterally,

straight, slender, with smooth surfaces inclined from above downwards and from within outwards, with a posterior extremity prolonged outward as a spur. It articulates anteriorly with the intermaxillary bone, posteriorly with the pterygoid, at the center of its superior border with the prefrontal and at the same level, upon its internal surface, with the palate. The inferior border is provided with teeth.

Os en Ceinture.—As designated by Cuvier, this bone represents the frontals, parietals and ethmoid. Ecker describes separately the fronto-parietals and ethmoid. This bone, which is large, has a groove, in the median line, on the superior surface and is bent around at the level of its anterior extremity so as to change its plane and is directed backwards towards the sphenoid, with the point of which it unites. The anterior extremity, which, alone, takes part in forming the nasal skeleton,

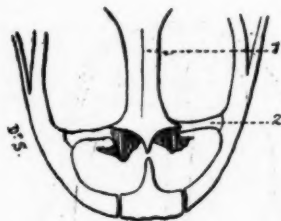


Fig. 8. Natural size. Frog (dorsal surface of skull). 1. Os en ceinture (fronto-parietal); 2. Prefrontal.

presents a median ridge separating two very deep grooves which constitute the base of each nasal cavity. In the center of this depression is an orifice for the passage of the olfactory nerve.

Prefrontal (Fig. 8).—(Frontal-nasal of Ecker.)—Bilateral, quadrangular, slender, directed transversely, situated immediately beneath the skin adjacent to the palate, with which it is almost parallel. It passes from about the middle of the superior border of the maxillary to articulate with the antero-external angle of the *os en ceinture*. It forms a simple truss upon the nasal roof.

Palate.—Bilateral, flattened, slender, directed transversely, passing from the middle of the superior border of the maxil-

lary a little in front and below the prefrontal to the inferior surface of the *os en ceinture*. It is more slender in its middle portion than at either end.

Vomer (Fig. 9).—The vomer is a bilateral bone placed on the same plane as the corresponding palate, presenting two surfaces almost smooth, one superior and the other inferior. It has an antero-posterior diameter of three millimeters and a transverse diameter of two. Its anterior border runs obliquely downwards, its posterior border is united with the palate and the adjacent portion of the *os en ceinture*. The antero-external and antero-internal angles present long osseous points, an intermediate point originating on its anterior border. The inferior surface is provided with teeth.

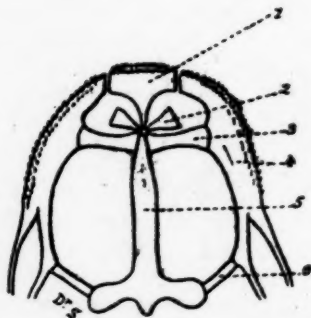


Fig. 9. Natural Size. Frog (inferior surface of cephalic skeleton). 1. Intermaxillary; 2. Vomer; 3. Palatal; 4. Superior maxillary; 5. Sphenoid; 6. Pterygoid.

The maxillary and intermaxillary are united to form the arch of the upper lip. The *os en ceinture* and superimposed pterygoid constitute a thick column upon which the prefrontals, palate and vomers rest. A true osseous nasal cavity does not exist. It is a simple interspace in which the cartilaginous capsule is placed.

Wiedersheim (1877) presents an extensive, well-illustrated study of the skull in the urodeles. In *Menobanchus lateralis*, the nasal capsule is limited anteriorly by the intermaxillary or premaxillary, superiorly by the frontal

and inferiorly by the vomer. The bones are large; they surround nasal fossae which are much more complete. In *Batrachoseps attenuatus*, the large bones of the superior wall are the premaxillary, with a large, long ascending process directed posteriorly, upon each side of which the nasal bones are placed. Between the nasal and maxillary, there is a small bone, the prefrontal. The inferior wall is formed by the vomer. The internal half of the bone is prolonged posteriorly and this portion has teeth upon its posterior edge.

Triton viridiscens has very large nasal bones in contact along their internal border, the ascending process of the premaxillary filling up the defect. On the other hand, the premaxillary is very much spread out upon its inferior surface, which has a quadrangular form. The vomer, which is very large, is hollowed out upon its posterior border in order to permit the choanae to pass; the postero-internal angle is prolonged backward in the form of a long apophysis resting against the inferior surface of the parasphenoid.

The species examined by Wiedersheim are numerous. All possess a nasal skeleton arranged in such a manner as to limit the true nasal cavities.

NASAL MUCOSA.—The cells of the nasal epithelium are arranged by Exner in two groups: epithelial cells and olfactory cells. Max Schultze and Hoffmann do not agree with this author, but admit two very distinct forms of cells. Max Schultze in *Proteus* described olfactory cells and supporting cells. Babuchin found olfactory cilia upon the olfactory cells and established the absence of vibratile cilia on the supporting cells. Blaue (1884) studied the mucosa of the lower Amphibia, and found, particularly in *Proteus*, numerous points of resemblance with that of the plagiostomes. There are folds, of slight height it is true, covered with stratified epithelium with flattened cells. The most superficial cells have a cubical form and their free surface permits the implantation of vibratile cilia.

In the interval of the folds, exist the long cells described by Schultze and Babuchin, disposed in groups forming olfactory buds. Blaue represents them in several plates. The buds have the same appearance as those of fish. In the triton and salamander, the essential details are analogous.

The *Anura* have two kinds of cells; epithelial cells or supporting cells (Ecker, Vogt and Yung) described by Exner, Max Schultze and Hoffmann. The first are long and slender

with a large nucleus forming an ovoid enlargement from which the cell is prolonged in the form of a long varicose filament, which comes into relation with the filaments of the olfactory nerve. The extremity which is directed towards the nasal lumen appears either as a brush with delicate hairs or as a single stiff hair. The other cells, which are cylindrical, long and unprovided with cilia, are prolonged into the subjacent connective tissue by a long and irregular filament. In the

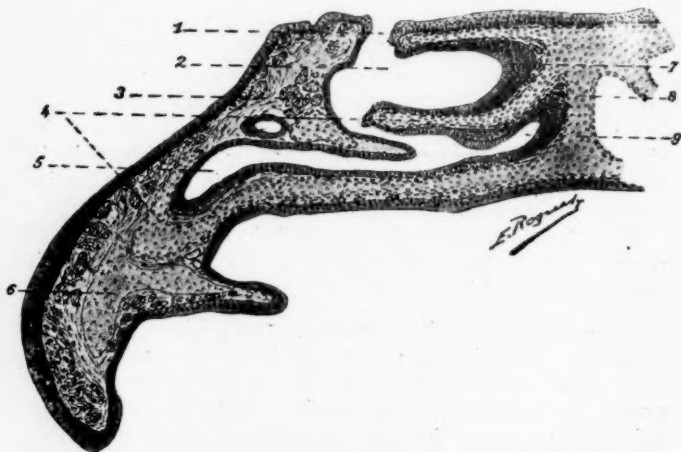


Fig. 10—X 27. Frog (transverse section showing the nasal cavity opening externally and communicating with the inferior cul-de-sac). 1. External nasal orifice; 2. Principal nasal cavity; 3. External nasal gland; 4. Cartilaginous capsule; 5. Infero-external cul-de-sac; 6. Superior maxillary; 7. Olfactory region; 8. Cartilaginous septum; 9. Infero-internal cul-de-sac (organ of Jacobson).

lower Amphibia, the epithelium is uniform in the nasal cavities. There is no distinction possible between the respiratory and olfactory epithelium. In the urodeles (triton), however, Mihalkovics (1899) found that the epithelium over the greater portion of the lateral fossa has the characteristics of respiratory epithelium, with mucous secretion. There were remains of the rays of olfactory epithelium. The branches of the olfactory nerve, according to this author, extended only

to the roof of the lateral fossa. In the Anura, there is a very distinct demarcation between the respiratory epithelium and the olfactory epithelium in the principal nasal cavity and in the accessory. Seydel considers the epithelium as olfactory in the entire extent of the accessory cavities. Mihalkovics reports the existence of an indifferent epithelium throughout the external region (recessus maxillaris).

According to my observations upon different Amphibia, the nasal epithelium is characterized by cylindrical elements such as those described by the preceding authors. Their topographic distribution presents some differences when comparing one group with another. In the urodeles (axolotl, triton), the nasal cavity and the diverticulum which it sends downwards and outwards are covered uniformly with the same type of cylindrical epithelium with very long cells. In the axolotl, however, the highest points of the nasal mucosa are less prominent.

In the frog, it is necessary to distinguish several regions in the nasal organ (Fig. 10). The principal cavity is entirely covered with thick epithelium of which the superficial elements are cylindrical. These elements, as in the urodeles, and for that matter in all the vertebrates, present a clear, homogenous, pinkish gray central segment.

The thickness of the epithelium upon the internal wall reaches 135 mikra. As it approaches the external nasal orifice, the epithelium is gradually lessened, forming a covering 21 mikra in thickness composed of two or three layers of polyhedral cells with large nuclei. In the infero-internal cul-de-sac, the epithelium, which is very thick (150 mikra), is of a sensory nature. It is here that the cells are highest, reaching 40 mikra. In the middle and infero-external cul-de-sacs, the epithelium, about 35 mikra in thickness, presents a superficial layer of cubical ciliated cells. At the level of the choanae, the thick epithelium of the principal nasal cavity is gradually merged into the buccal epithelium.

GLANDS.—In the vicinity of the buccal and nasal cavities, numerous glands are found in the Amphibia. In the frog and toad, the entire mouth and the region anterior to the nasal sacs are occupied by an enormous number of cul-de-sacs and glandular ducts. Several groups are connected with the nasal mucosa. Born and Ecker have studied these. Two groups correspond to the nasal cavity and two other groups to the

buccal cavity. Upon transverse sections three groups (Fig. 10) are found: an external placed upon the external wall of the nasal cavity, composed of a large number of tubes agglomerated into a mass with quadrangular form, bounded above by the nasal vestibule (a portion of the cavity which is directed towards the depression of the skin which corresponds to the external nasal orifice), externally by the integument, internally by the nasal mucosa, inferiorly by a portion of the cartilaginous capsule. This is the superior gland of Born, whose ducts are situated around the lachrymal canal.

An inferior group is placed above and within the inferior extremity of the infero-external diverticulum. A fibrous band limits this glandular mass and permits it to be in direct connection with the mucosa of the diverticulum, altogether removing it from the buccal cavity. This group, very extensive antero-posteriorly, is in connection posteriorly with the buccal roof. It is the pharyngeal gland of Born which, at its anterior portion, approaches the buccal mucosa and merges with the median mass situated anterior to the cartilaginous capsule. This median mass, which is far anterior, is prolonged posteriorly below the nasal septum and is the intermaxillary gland of Born.

An internal group, placed upon the septum in the cartilaginous capsule of the infero-internal cul-de-sac and represented in Fig. 10 only by some tubes, acquires, in the posterior sections, considerable importance and fills up the entire posterior part of the diverticulum corresponding to the fibrous capsule. This is the inferior gland of Born.

The nasal glands comprise the external or superior gland and the internal or inferior gland. The intermaxillary is a buccal gland, but Born describes it as having numerous openings in the inferior cul-de-sac. The inferior or pharyngeal gland opens into the infero-external cul-de-sac and into the buccal cavity. The groups scattered along the buccal roof, especially in the anterior portion, end in the buccal cavity.

The glands are less abundant in the triton. Two important groups are found: the external gland, the ducts of which form a true diverticulum of the nasal cavity; the intermaxillary gland, well developed and exclusively buccal, except some tubes scattered upon the anterior part of the palatal vault. Their arrangement is almost analogous to that of axolotl.

According to the investigations of Blaue, the lower Amphibia, such as the proteus, do not have any glandular formation.

The glandular cells in all of these groups are cylindrical and have a nucleus situated in the basal part and an extremity, directed towards the lumen, clear and filled with homogenous protoplasm. These are mucous cells. Their existence is a formal indication of the adaptation of the animal to life in the air. According to Bruner, the muscles around the external nasal orifice evacuate the mucus of the external nasal gland into the nasal cavity at the moment when they contract so as to close this orifice when the animal plunges into the water.

NASAL CAVITY.—We have already described in the nasal cavity a principal portion and two diverticula: an inferior diverticulum and a middle diverticulum interposed in the anterior region between the nasal cavity proper and the inferior diverticulum, and branching from the canal of communication between the two cavities. The middle diverticulum, or lateral diverticulum of Born, is at no point entirely covered by cartilage; its external wall is always uncovered; it is in relation with the cul-de-sacs of the external gland and with the lachrymal canal; it is the first step towards perfecting the nasal cavity, and thus increases its respiratory region. According to Seydel, the existence of this cul-de-sac is intimately connected with that of the lachrymal canal; it is absent in the proteus and siren, which have no lachrymal canal, and also in the Gymnophiona, in which the lachrymal canal opens into the organ of Jacobson. This extension is still further manifested by the presence of the inferior cul-de-sac. This begins in front of the anterior extremity of the nasal cavity proper and extends to the choanae. Its transverse extent is considerable; we may observe two portions: an internal between the septum and the canal of union to the nasal cavity, and an external situated external to the canal and extended far externally and inferiorly almost to the maxillary bone. The internal portion is shorter than the nasal cavity and the external portion; it terminates a little in front of the choanae. Therefore, in a posterior section in the neighborhood of this orifice, two cavities are to be seen: a large one, internal and superior, the nasal cavity; another external and inferior, the infero-external diverticulum, which Seydel calls the lateral nasal canal; this is the portion which extends to the posterior limit of the choanae. Born (1876) attributes to the

inferior cul-de-sac the importance of a maxillary cavity homologous to the sinus maxillaris of mammals. The direct relation of this to the buccal cavity at the level of the choanae, according to him, depends upon the shortness of the frog's palate; the length of the palate in the higher vertebrates brings the maxillary cavity into exclusive relation with the nasal cavity.

According to Seydel, the inferior cul-de-sac represents the organ of Jacobson. Goette, Fleischer, Koelliker had already expressed this opinion. The Sarazin brothers considered the middle cul-de-sac homologous with this organ. The investigations of Seydel were made upon the entire series of Amphibia: *Perennibranchiata*, *Gymnophiona*, *Urodela*, *Anura*. He showed in all of these the existence of a fossa (diverticulum upon transverse sections) situated in the inferior part of the nasal cavity, beginning forward in a cul-de-sac and terminating posteriorly in the choanae, in which it opens extensively. This fossa, which is simple in the three first groups, is complicated in the *Anura*, in which it forms a true inferior cavity which possesses, as we have seen, external and internal diverticula. But this inferior cul-de-sac, according to Seydel, from its position and connection, is homologous to the fossae of the other groups. These formations covered with sensory epithelium and receiving the branches of the olfactory nerve, constitute an olfactory region placed in the passage for the respiratory air in order to exercise a sensory control. Burckhardt (1891), who described this fossa in the triton, demonstrated its innervation from the olfactory nerve and considered it the organ of Jacobson. Wiedersheim (1902) accords to it the same function.

The absence of a fossa of this sort in *Proteus* and *Menobranchus*, established by Seydel, is a new proof demonstrating their more primitive organization. It is the increasing extension of this fossa which causes the complicated disposition in the higher forms.

In the triton, there is a fossa placed at the infero-external angle of the nasal cavity passing outward into the maxillary region in continuous communication with the nasal cavity and terminating at the level of the choanae. This fossa, as in the inferior cul-de-sac of the *Anura*, has, according to our observation, for its principal role the enlargement of the respiratory region and its constant termination at the level of the choanae seems to us to be in favor of this function. In the lower species, in which the division of the nasal mucosa into olfactory

and respiratory zones is not established, the fossa has the function of participating in the olfactory sense, but it is not organized into a true organ of Jacobson. Mihalkovics (1899) refuses to accord to this fossa, as Seydel does, the value of an organ of Jacobson. The distant position of the septum and the presence of respiratory epithelium in this zone has made him insist that it represents the recessus maxillaris.

In Anura (*Rana esculenta*, *Bufo vulgaris*), a portion of the inferior cul-de-sac is differentiated and one could say that in these animals it appears as a true organ of Jacobson. It is the internal segment (infero-internal diverticulum) of the inferior cul-de-sac which we consider thus. The epithelium at this level has all the character of a sensorial epithelium. It is on the presence of this epithelium localized in the infero-internal diverticulum that Mihalkovics has based his opinion that the organ of Jacobson is confined to that part of the inferior diverticulum. A very important gland, the internal gland, opens into this diverticulum. Seydel observed it in relation to the inferior cul-de-sac and called it the gland of Jacobson. Burckhardt and, later, Seydel found these glandular cul-de-sacs in relation with the fossa in the urodeles, and gave to them the same denomination as in the Anura.

With regard to the exterior portion of the inferior cul-de-sac of the Anura, we consider it as forming a simple extension of the respiratory region. The functional division of this cul-de-sac agrees with the respiratory role of the nasal cavity.

Seydel does not admit the homology of the inferior cul-de-sac with the sinus maxillaris of mammals as Born claims. It is, nevertheless, the first appearance of an exclusively respiratory region, which represents not a true sinus maxillaris, but rather a zone which, in reptiles, birds and mammals, is situated below the inferior turbinate.

The nasal cavity of the axolotl closely resembles that of triton, showing the same external cul-de-sac. The epithelial wall is very thick, averaging 300 mikra. The nasal lumen is effected by the sinking in of the thick portions of this wall in the form of fissures. Between these fissures, the distribution of which is very irregular, are found circumscribed folds with a thick base. At the summit of the projecting portions, the thickness of the epithelium is only 75 mikra. The projections represent the folds of the nasal mucosa of fish, and constitute a morphologic character, permitting the grouping of the water-breathing animals with those of the air-breathing class.

REPTILES.

We have studied especially the saurophidians and the crocodilians; we have made few observations on the chelonians.

I. SAUROPHIDIANS.

The adder, blindworm, viper, python, boa and the galeote form the basis of our description. The nasal organ in these animals has pretty much the same disposition.

ORIFICES.—The external orifice in the adder is pierced in the center by a scale in the neighborhood of the end of the snout, upon the lateral side of the head. This orifice, which is circular, surrounded anteriorly, superiorly and inferiorly by a very distinct border, does not project beyond the plane of the integument, but is in distinct relief, and has no border internally and posteriorly, where the surface of the scale forms the limit of the orifice. In the python, this orifice is placed upon the dorsal surface of the snout.

The galeote presents an external orifice pierced at the center by a scale; it is round, very distinctly limited throughout its periphery, and is placed midway between the anterior border of the orbit and the end of the snout upon the line of separation between the dorsal and external surfaces.

A large number of observers have reported that reptiles which live in the water have nasal orifices placed upon the dorsal surface of the head—they need expose but a small portion of the snout in order to breathe the air. To prevent the water penetrating the nasal cavities when the animal plunges into the water, there is a sort of valve at the edge of the external orifice. According to Cantor, a valve is present; according to Duméril and Bibron, there are movable membranes which take the place of valves. Schmidt, Pagenstecher, Hoffmann, Brehm, Fleischmann and Kathariner (1900) report a valve as present. Furthermore, Kathariner describes an arrangement which constantly and without expenditure of muscular work closes the nasal orifice and accomplishes the necessary work when the air passages need to be opened for the purposes of respiration.

The posterior orifice of the ophidians opens at the level of the palatal vault in an antero-posterior fossa, limited above by the

palatal vault, below by a kind of transverse membrane extending from one to the other of the projections which border the fossa laterally. At its anterior extremity, this communicates with each nasal cavity by a large orifice situated in a plane oblique from above downward and from behind forward. This canal, separated from the buccal cavity where the choanae open, is found in all the ophidians. The choanae of the galeote are placed on the anterior third of the palatal vault; they are elliptical orifices with the long axis antero-posteriorly, opening freely into the buccal cavity, and are placed immediately external to a median ridge of the palatal vault, which supports two round tubercles. This is the usual disposition of the choanae of the saurians.



Fig. 11. Natural size. Python (Sagittal section showing the external wall of the nasal cavity with the turbinal). 1. Turbinal; 2. Vestibular orifice; 3. Choana.

NASAL CAVITY.—From the external orifice, we enter an almost cylindrical passage, which opens inferiorly and posteriorly into the nasal cavity proper. This is the vestibule described by Leydig (1872) and Born (1879). In the python, a large, round orifice establishes the communication of the vestibular passage-way with the nasal cavity. The blind-worm has a vestibule less distinctly separated from the nasal cavity. It is simply the anterior portion narrowed. The histologic characteristics permit this distinction between the two spaces, which is also found in the adder. Leydig, in *Lacerta*, describes the vestibule as a passage-way slightly elevated, which connects a fossa with the external nasal orifice.

Solger (1876), in *Lacerta*, *Anguis*, *Leguan*, *Chameleo*,

Hemidactylus, showed that the two nasal spaces communicate by a more or less narrow orifice, which runs in various planes, e. g., parallel to the longitudinal diameter of the head (Laguan), or to the transverse diameter (Lacerta), or even oblique (Chameleo). This author remarks the constant absence of a vestibular turbinal analogous to that which we shall describe in birds.

The principal nasal cavity is quadrilateral in form and, with the vestibule, consists of a long cartilaginous sac. The external wall in the python (Fig. 11) presents a cartilaginous fold, the turbinal, which is free at its superior border, adherent at its inferior border and extremities. We find it in the boa; it is very much reduced in the adder and in the galeote, but it attains a considerable importance in the blind-worm. Stannius, Leydig, Born, Gegenbaur and Solger have described this single turbinal in reptiles. Born studied minutely the turbinal of Lacerta and notes its rectangular deflection. In the blind-worm, the turbinal, by its anterior extremity, forms a simple prominence on the lateral wall, then progressing backwards is elevated, pedunculated and rolled up (Fig. 12). On transverse sections in the middle portion, the turbinal appears as a graceful projection arising from the inferior portion of the external wall directed internally and superiorly, then becoming bent and directed internally and inferiorly. It presents a free border looking downward and considerably enlarged. At the posterior portion of the cavity, the turbinal is prolonged behind by its pedicle in such a way that transverse sections at this level show the turbinal isolated in the center of the nasal cavity.

According to the definition of Gegenbaur, the turbinal should be a projection extending from the nasal wall by a narrow portion. Solger and Mihalkovics did not find this characteristic in that of reptiles, and called it a false turbinal (*pseudoconcha* of Solger), comparable to the superior turbinal of birds. If their observation is correct for a number of types, galeote and adder, it is not the case with the python and still less with the blind-worm. It is only necessary to compare Figs. 12, 18 and 20 to see the resemblance which exists between the turbinal of this animal, the middle turbinal of birds and any turbinal of the mammals. By its position and great development, it appears to correspond to the maxillary turbinal of the mammals.

No hollow cavity is found in the bones or cartilages of the nasal region. There is no homologue of the infero-external diverticulum of amphibians or the sinuses of birds and mammals. In the anterior vestibular region there is found under the cartilaginous floor of the nasal cavity, situated near the septum, a passage-way with thick walls, which anteriorly and posteriorly is represented by a solid mass. The

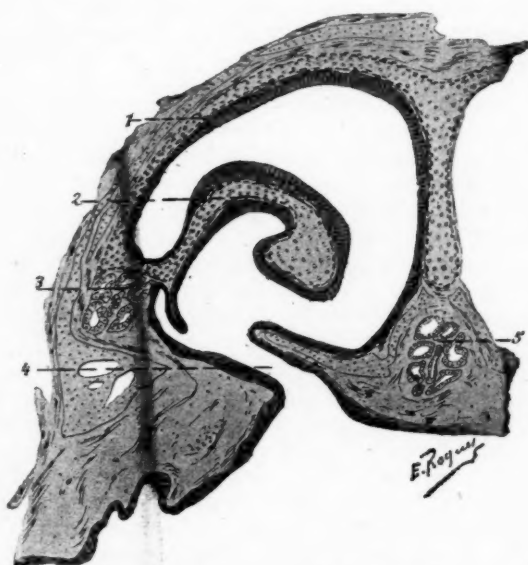


Fig. 12—X 34.3. Adder (transverse section of the nasal cavity, turbinal and choanal canal). 1. Cartilaginous capsule; 2. Turbinal; 3. External nasal gland; 4. Choanal canal; 5. Intermaxillary gland.

lumen of this passage-way is narrow in comparison to the thickness of its walls. The superior wall is the thickest. The inferior wall in its middle portion is projected into the lumen in the form of a convex pad, resembling a mushroom in transverse section. At this level, the lumen upon transverse section is reduced to a fissure with inferior concavity. This passage-way is the organ of Jacobson. Behind the mushroom-like pad, the floor presents a narrow fissure which establishes

the communication with the buccal cavity. Mihalkovics found this orifice in the lizard upon the side of the palatal papilla. The cartilaginous nasal septum separates the two organs of Jacobson. A cartilaginous box envelopes this organ and separates it from the nasal cavity on one side and from the buccal roof on the other. The posterior extremity of the organ of Jacobson corresponds to the anterior part of the turbinal. The different ophidians and saurians studied by Leydig (1897), Born (1879), Beard (1888) and Mihalkovics (1899) possess a well-developed organ of Jacobson, analogous to that of the blind-worm.

NASAL SKELETON.—The nasal cavity is completely enveloped in a cartilaginous sac which follows all of its contours. Internally the two sacs are fused, forming the septal wall, which is greatly extended vertically, even to the buccal roof. The external wall of the nasal cartilage sends out a lamella which becomes the axis of the turbinal. In the posterior part of the nasal cavity, the cartilage becomes thin near the floor and disappears in such a manner that the nasal mucosa and the buccal mucosa are attached to each other in the neighborhood of the choanae.

The bones of the nasal region lie external to the cartilaginous wall. We studied these bones in a python of large dimensions. The nasal cavity is bounded above by the nasal and prefrontal, internally by the vertical plate of the nasal, the vomer and the intermaxillary, below by the vomer and palate and externally by the prefrontal and maxillary (Fig. 13).

Intermaxillary.—Small, single bone composed of two parts, of which the posterior, flattened and arranged as a vertical lamina, is connected to the other which forms a transverse wall, upon the inferior surface of which the teeth are implanted. Laterally, it is united with the maxillary.

Maxillary.—Double bone, compact, elevated in front, becoming thinned out at its posterior extremity. The external face, which is smooth, is slightly oblique from above downward and from within outward. The internal face is smooth and slightly excavated. The inferior border is supplied with teeth. The round exterior extremity unites loosely with the intermaxillary. The posterior extremity is united with the transverse portion and the middle portion of the superior border with the prefrontal. It unites with the palate by a ridge on the internal surface near the superior border.

Palate.—Double bone, slender, almost cylindrical, with the inferior surface flattened and supplied with teeth. A prolongation from the internal border articulates with the posterior extremity of the vomer and the anterior extremity of the sphenoid. This prolongation is situated in the posterior third of the bone. The anterior extremity is free and the posterior extremity is articulated with the pterygoid. The middle portion of external border is in contact with the maxillary.

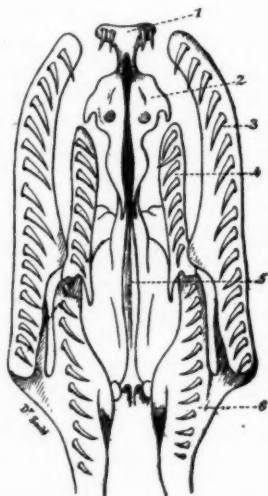


Fig. 13. Two-thirds natural size. Python (skull seen from its inferior surface). 1. Intermaxillary; 2. Vomer; 3. Superior maxillary; 4. Palatal; 5. Sphenoid; 6. Pterygoid.

Vomer.—Double bone as in the amphibians, formed of two laminae, the vertical one contributing to form the nasal septum in connection with that of the opposite side, and a lamina directed horizontally outward, with the superior surface concave and limited by a greatly elevated external border. This lamina exists only in the anterior third of the bone, but its border is prolonged backwards under the form of a very slender process. The bone has the shape of a fish hook. The

vomer articulates above with the nasal, externally with the prefrontal and posteriorly with the inferior surface of the sphenoid.

Nasal.—Double bone, large and slender, with the superior surface convex transversely, while its inferior surface is concave in the same direction. The internal border is rectangular, the external border uniform, so that the bone resembles a crescent. A lamina extends from the internal border vertically downward and joins with the vertical lamina of the vomer. The intermaxillary lies between the anterior extremities of the nasal bones.

Prefrontal.—Double bone, triangular, formed of two laminae, an anterior horizontal, the other almost vertical and directed downward, extending from the posterior border of the bone and constituting an orbital process. The anterior angle of the horizontal lamina is inserted between the frontal and maxillary. The external border is in contact with the nasal bone and the posterior part of the external border with the maxillary. The posterior border or base of the triangle is articulated by its internal half with the frontal, and by its external half aids in forming the orbit. Fischer (1900), in the *Amphisboenia*, noted the general plan of the structure of the saurians, and described several points of divergence in the skeleton, particularly the imperfect development of the cartilaginous envelope.

NASAL MUCOSA.—In the vestibular region, the mucosa presents a stratified pavement epithelium. At the posterior limit of the vestibule, a transition is effected between this indifferent epithelium and the respiratory epithelium. In this zone, the inferior wall and a part of the internal wall are covered with stratified pavement epithelium, while the superior wall, the external wall and a part of the internal wall are covered with stratified epithelium, of which the most superficial layer is composed of cylindrical, ciliated cells. In the blind-worm, the respiratory region anterior to the turbinal presents a diverticulum placed at the level of the external border of the floor and directed horizontally outward, the lateral recess of Mihalkovics.

All over the turbinal, the mucosa is of the respiratory type. The corium of the turbinal contains numerous blood vessels and glands. The axis of the turbinal is formed by a

cartilaginous lamina extending from the nasal capsule, which is of slight thickness but is enlarged at the level of its free border.

The epithelium is very thick, the layers of round cells are very numerous, the superficial layer is formed by very high cells with basal nuclei. They are clear and refractive in their remaining portions. At the level of the nasal roof and of the superior border of the turbinal the thickness of the epithelium is 85 mikra and 50 in the portion adjacent to the turbinal.

In the saurians, Mihalkovics described olfactory epithelium in a considerable portion of the cavity; the respiratory epithelium covers only the inferior surface of the turbinal. This author finds many Bowman's glands in the olfactory mucosa.

Max Schultze describes, in the adder, blind-worm and lizard, cylindrical epithelial cells which never have any vibratory cilia, and olfactory cells provided with a bundle of long cilia.

GLANDS.—The mucosa of the blind-worm contains in the corium some few glandular tubes which are found along the external and internal walls. There is only one large gland in relation with the nasal cavity, which is situated externally towards the middle portion of the external wall. This glandular group begins at the level of the posterior portion of the vestibule and acquires a considerable importance at the level of the lateral diverticulum of the respiratory region, and continues as far as the middle of the turbinal.

ORGAN OF JACOBSON.—We have seen the situation and form of the long canal; it is enveloped in a cartilaginous tube which is connected with the septum and the nasal capsule. The vomer and the palate are the bones protecting this cartilaginous envelope inferiorly and internally.

Leydig (1897) describes, at length, the organ of Jacobson in serpents. Two bones are in relation with it, the turbinal and the vomer; its cartilaginous wall is connected above with the nasal cartilage. Mihalkovics (1900), in the adder and *Lacerta agilis*, represents and describes the vomer as forming the roof of the organ of Jacobson, which it separates from the nasal cavity, and the intermaxillary as constituting a part of the floor and of the internal wall.

Internally, the cartilaginous wall presents a mucosa with a very thin corium and very thick epithelium. On the dorsal

wall, the thickness of the epithelium is 257 mikra and on the ventral 42. We find in the blind-worm and viper, at the level of the dorsal wall, a large quantity of round cells, crowded closely together. The superficial layer is composed of very high cells (54 mikra), having a basal nucleus, clear in the remaining portion. At the level of the floor, and especially on the ridge which it forms in the cavity, the epithelium is much thinner than that of the roof; the cells have a superficial clear segment and terminate in a border supporting the cilia; their height is 16 mikra.

Wright (1883) describes a well-developed neuroepithelium upon the roof of the canal of Jacobson, while the floor is covered with an epithelium composed of shorter cells provided with cilia. Leydig found cylindrical cells in the epithelium of Jacobson, and described numerous fibres of the olfactory nerve and nerve cells in the corium. Mihalkovics found cells with cilia of various lengths in the epithelium of the floor. In several places, there was a slightly elevated cuticle upon the superior wall. He found, at the external limit of the layers of small cells, a capillary network in which the branches penetrated in a radiate direction into this layer. The olfactory cells showed the limiting membrane of Brunn through which the fine, short olfactory filaments projected.

The organ of Jacobson is greatly developed among the sauropidians, and Beard accounts for the relative simplicity of the nasal cavity on this ground.

Mihalkovics (1899) notes the narrow communication of the organ of Jacobson with the buccal cavity in serpents, but does not agree as to this organ with the opinion of Seydel, who accorded to it, in the Amphibia, the role of sensory control of the expiratory current. He considers it an organ whose purpose is to perceive genital odors, which are well developed in all crawling animals, being absent in fish and birds, which have recourse to their visual apparatus, and atrophied in man because of the development of the intelligence and the retrogression of the olfactory powers.

II. CROCODILIA.

The nasal fossae of the crocodile are more complex than those of other reptiles. The external nasal orifices are placed upon the dorsal surface of the snout in the vicinity of the

anterior extremity and almost in the median line. They are of small dimensions, of elliptical form and directed obliquely from within outward and from behind forward. The choanae open upon a plane horizontally placed upon the prolongation of the palatal vault; they are situated about 2.5 cm. from the insertion of the palate. They are of quadrangular form and have bony boundaries throughout.

The external orifice begins as a vertical canal about 1 cm. in height and bends so as to become horizontal, making a sort of nasal vestibule. Its dimensions increase from before backwards and it becomes a very large cavity, especially in a vertical direction. This cavity contains a long, large, round ridge inserted in the roof of the nose, free on its inferior

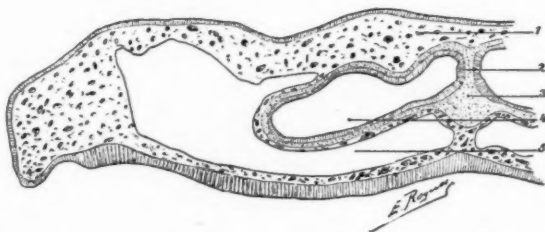


Fig. 14. Half natural size. A. Crocodile (transverse section passing through the anterior region of the nasal cavity). 1. Maxillary; 2. Nasal mucosa; 3. Cartilaginous septum; 4. Nasal lumen; 5. Maxillary cavity.

border. It is a true turbinal. This is of cartilaginous consistency. Another ridge occupies the bottom of the cavity formed at the expense of the external surface, upon the entire vertical extent of which it has its insertion. It is a false turbinal according to the definition of Gegenbaur.

The floor of the vestibule is convex. Posteriorly, at the limit of the principal nasal cavity, it becomes depressed into a fossa and leads to a cylindrical canal which occupies the most internal and inferior portion of the principal nasal cavity. This canal, circumscribed by an osseous wall, opens into an osseous canal of the same form, but much larger, which terminates in the choanae.

The various details may be well seen in a series of trans-

verse sections. Section A (Fig. 14) passes across the vestibule; the section of the cavity is elliptical. It is surrounded by a cartilaginous wall. Internally this forms a septum. The floor is entirely cartilaginous. At the level of the roof and externally, a very thick osseous wall is observed. The very large maxillary cavity is situated external and inferior to the vestibule. Section B (Fig. 15) shows the principal nasal region. The nasal cavity has an irregular form and presents the turbinal which is pedunculated, has an axial cartilaginous skeleton and is inserted on the dorsal region of the nasal capsule. The external wall is markedly convex and cartilaginous, and is constituted by the surface of the false turbinal, which is hollow. Its cavity appears on section. The

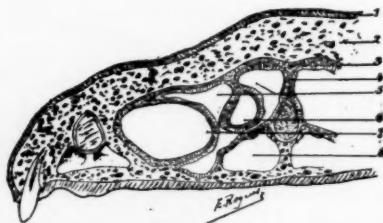


Fig. 15. Half natural size. B. Crocodile (transverse section passing through the middle portion of nasal cavity). 1. Skin; 2. Superior maxillary; 3. Cartilaginous capsule; 4. Nasal mucosa; 5. Olfactory region of the nasal cavity; 6. Turbinal; 7. False turbinal; 8. Respiratory region of the nasal cavity.

inferior half of the internal wall is also convex, due to a cylindrical osseous canal placed below the septum and adjoining a similar canal on the opposite side. The posterior portion of the cavity is a simple cylindrical osseous canal covered with a thin mucosa, analogous to periosteum.

As Section B and the antero-posterior sections show, there are two small nasal cavities behind the vestibule. The cavity containing the turbinals terminates in a cul-de-sac and the cylindrical cavity, prolonged posteriorly, which leads the respiratory current directly from the vestibule to the choanae. The olfactory apparatus is distributed only to the principal nasal cavity which contains the olfactory nerve. The superposition and complete separation of the olfactory cavity from

the respiratory cavity is very remarkable and does not exist anywhere else. In the tortoise, this division is well established, but the two canals communicate with one another.

The respiratory canal is bony; the other is cartilaginous and completely surrounded by very large and thick bones.

NASAL SKELETON.—The bones bounding the nasal cavity are superiorly the nasal, prefrontal, a part of the maxillary and the intermaxillary; inferiorly the intermaxillary and the palatal lamina of the maxillary; externally the maxillary, internally the cartilaginous septum. The interior of the cavity thus circumscribed encloses the respiratory region, limited by the ethmoid and the palatal in its anterior half, and hollowed out of the pterygoids in the posterior region (Fig. 16).

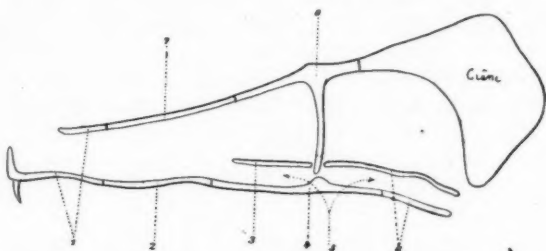


Fig. 16. Half natural size. Crocodile (Sagittal section of the skull passing somewhat external to the median line). 1. Intermaxillary; 2. Palatal lamina of the maxillary; 3. Ethmoid; 4. Palatal; 5. Respiratory region of the nose; 6. Pterygoid; 7. Nasal; 8. Prefrontal.

Intermaxillary.—A double bone, of which one wall constitutes the external surface and inferior border, the latter provided with teeth. The external surface is rough, a characteristic found in all the bones immediately subjacent to the skin. The palatal lamina, directed horizontally inward, extends from the lower border of this wall; the free border is thin and hollowed out at the middle portion. The internal surface of the lateral wall is concave vertically. This bone articulates internally with that of the opposite side and posteriorly with the nasal and maxillary.

Nasal.—Double bone, long and flat, trapezoid in form, with a large internal base. The inferior surface is slightly concave

transversely. The internal and external borders are rectangular, the anterior and posterior, squamous and bevelled. It articulates internally with the bone of the opposite side, externally with the maxillary, anteriorly with the intermaxillary and posteriorly with the prefrontal and frontal.

Maxillary.—Double bone, of large dimensions, quadrilateral, with rough external and superior walls and an inferior border supplied with teeth. The palatal lamina is flat, its free border rectangular. The internal surface of the bone is concave and forms a longitudinal fossa by uniting with the palatal lamina. It articulates anteriorly with the intermaxillary, posteriorly with the prefrontal, the lachrymal and the jugal, internally with the nasal by its superior border and by the palatal lamina with that of the opposite side.

Prefrontal.—Double bone, limiting the orbital cavity, the inferior surface of which sends out a process directed vertically downwards, which establishes the solid relations between the vault and the nasal floor by articulating with a process of the palate. This bony interval is the posterior limit of the olfactory region.

Palatal.—Double bone, quadrilateral and thin; the internal portion of its superior surface is hollowed out by a longitudinal groove. A thick process is projected vertically upward from its middle portion to articulate with that of the prefrontal. The inferior surface is flat and thin, the internal border rectangular; the external border oblique from without inwards in the anterior half where it is thin. Behind, it is thick. The anterior and posterior borders are divided into lamellae. Internally, it is united with the bone of the opposite side, anteriorly with the palatal plate of the maxillary, posteriorly with the pterygoid, superiorly by its process with the frontal and by the edges of the groove on its superior surface with the ethmoid and pterygoid. It is thus that the respiratory canal is limited.

Ethmoid.—Double bone, long and lamellated; a vertical lamina constitutes the principal part of the bone; its external surface is hollowed out by a groove. About the inferior border and posterior half of the bone, a lamella projects outward and downwards. It is articulated below with the ethmoid of the opposite side, and also with the vomer (median

prolongation of the pterygoid); anteriorly it is insinuated between the two palatal laminae of the maxillary; by its posterior border it articulates with the process of the prefrontal. The external lamella articulates with the palate, forming a canal between these two bones.

Pterygoid.—Single bone, large in size, presenting a median body directed antero-posteriorly, which posteriorly stretches out in the form of a wing. It is prolonged anteriorly by a long coping, which represents the vomer (hérisséal of Geoffroy Saint-Hilaire).

The posterior border, which is very thick, presents a median tubercle and is bordered by high ridges. The superior surface presents a median fossa which is prolonged with one hollowed out on the vomer. The inferior surface, which is flat, is enlarged by lateral wings. It presents posteriorly two large orifices of almost quadrangular form which are the choanae. Each of these gives access to the canal hollowed out in the pterygoid. This bone is in relation anteriorly with the ethmoid, and the palate bones of the vomer, with the processes of the frontal and the palate by the lateral ridges, with the palate and the transverse by the anterior border of the wing, above with the pre-sphenoid, the basi-sphenoid and the alisphenoid.

STRUCTURE.—We cannot give the details of the structure of the mucosa of the nasal cavity of the crocodile. We found neither glands nor organ of Jacobson. Beard (1888) found no trace of the organ of Jacobson in the embryo. Howes (1891) described two cartilaginous sacs which represented the vestiges of this organ. Meek, in young embryos with a head measuring $5\frac{3}{4}$ to 7 mm. in length, considered a small invagination of the inferior part of the nasal cavity as a rudimentary organ of Jacobson.

Sluiter (1892), in young embryos, found an organ of Jacobson well developed, analogous to that of the lizard. There was no trace in old embryos. He concludes from this observation that the ancestors of the crocodile were provided with a perfected organ of Jacobson.

Roose (1893, 1), in a series of embryos having a head from 5 to $12\frac{1}{2}$ mm. in length, describes the organ of Jacobson as an evaginated cul-de-sac of the postero-inferior ex-

tremity of the nasal cavity. This evagination will develop into the posterior nasal canal, which in the adult forms the respiratory passage-way. The anterior extremity of the organ projects from the nasal passage-way in the form of a solid epithelial cone. Later, in an embryo with a head measuring 41 mm., the rudimentary organ appears under the form of a mucous fossa 2 mm. in length, lodged in the concavity of the vomer.

The absence of nasal glands in the crocodile is as universally admitted as that of the organ of Jacobson. However, Stannius, Wiedersheim, Gaupp, Roesé (1893, 2) described a large gland opening into the nasal cavity.

Roesé finds it between the cartilaginous roof and bony layer (premaxillary and nasal). It opens by one or two excretory ducts on each side of the septum in the posterior extremity of the external nasal orifice. This gland appears in the form of an epithelial bud in embryos with the head $12\frac{1}{2}$ mm. in length.

III. CHELONIANS.

According to the nasal skeleton of *Testudo mydas*, this group of reptiles may be considered as intermediate between the sauropodians and crocodilians.

The choanae open about the middle of the palatal vault and the pterygoid does not participate in the constitution of the hard skeleton as in the crocodile.

The ethmoids are large bones participating in the formation of the nasal fossa. The vomer is enlarged at its posterior extremity and aids in the constitution of the palatal vault. There exists, therefore, in these animals a special respiratory canal, but, according to Wiedersheim, it communicates by several orifices with the remaining portion of the nasal cavity. Seydel, who has studied the nasal cavity of the tortoise with much care, finds an organ of Jacobson well developed in them, in the form of a canal covered with olfactory epithelium. Mihalkovics represents this organ as a diverticulum transformed later into a canal lying against the nasal septum and covered with sensory epithelium.

BIRDS.

The nasal cavities in birds are hollowed out in part in the beak and in part in the facial walls, anterior to the orbital cavity.

ORIFICES.—The external nasal orifice is variable, in form, dimensions and situation, depending on the species.

Ornithologists distinguish basillar nasal cavities (at the root of the nose) median (at the middle of its length) and marginal (at the borders). They may be round, oval or linear. They are masked by hard plates in the crow, and by cartilaginous scales in the Gallinaceae. They are sometimes very small, as in the heron and pelican (Chatin), at other times freely open, of large dimensions and elliptical, as we have found in the duck. In the turkey, they are provided with a sort of valvular apparatus which protects the entrance of the nasal cavity. This animal has an external elliptical nasal orifice, looking outwards, bordered by a thick integument of dark color and scaly appearance. The framework is cartilaginous; no portion of the border is provided with bony support. A cutaneous fold extends diagonally from before backwards and from below upwards, dividing this orifice into two parts, an external part which is a simple cul-de-sac terminating at the posterior level of the orifice, the other internal, which leads into the nasal vestibule. In the external cul-de-sac, small solid particles (especially dirt) are found, which the anatomic disposition has prevented from entering further into the nasal cavity.

The nasal orifice of the duck, which gets its food at the bottom of muddy ponds, is wide, with no protecting apparatus.

The nasal fossae open together into the buccal cavity by a median fissure of the palatal vault, a simple cleft in the anterior portion, having the appearance of an elliptical buttonhole in the posterior half, in the turkey, duck and pigeon. The border of this orifice is composed of soft parts, of which the free border is provided with very long calcified odontoid papillae. The opening of the larynx in the form of a large elongated cleft is found at the level of the base of the tongue, immediately subjacent to the palatal orifice. The respiratory air passes, therefore, almost directly from the nasal cavity into the larynx. On lifting the borders of the palatal arches, the nasal septum is observed in the median line too short vertically to reach the

palatal vault, and on each side are to be seen the nasal cavities with an open floor.

NASAL CAVITY.—The nasal cavity has no bony wall, but is, as in *Anura*, limited by a cartilaginous sac. It is separated from the integument by a large empty space, larger below than above. If it is examined on longitudinal sections made a little external to the septum, it is seen to be considerably elongated in an antero-posterior direction. Its vertical diameter increases progressively from before backwards. An anterior region may be isolated from the rest of the cavity, the vestibule described by Born. Posterior the nasal cavity proper is found. The external wall is the seat of three very prominent ridges projecting into the cavity, representing the true turbinals. The

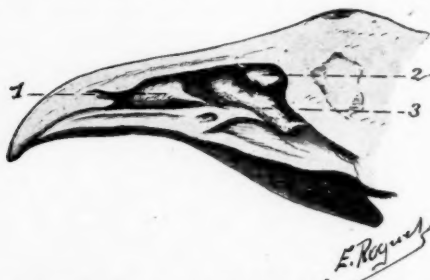


Fig. 17. Six-sevenths natural size. Turkey (Sagittal section, showing external wall and three turbinals). 1. Vestibular turbinal; 2. Superior turbinal; 3. Middle turbinal.

anterior turbinal, inserted in vestibular region, has the name of vestibular turbinal [Born (1879), Gegenbaur (1873), Mihalkovics (1879)]; the two others belong to the principal cavity. In the turkey, the vestibule represents about one-third of the whole cavity. It opens externally by the external nasal orifice, and communicates with the principal nasal cavity by a narrow cleft between the external wall and the posterior border of the vestibular turbinal. This turbinal, which is attached to the roof of the vestibule, is a true fold of the cartilaginous capsule, as are all the other turbinals. It descends from the entire length of the vestibule down to the floor, from which it is separated only by a narrow cleft. It is thin anteriorly, rolled up posteriorly, and presents an inferior border of bony consistency. It is a true sagittal septum dividing the vestibule

into two parts, an external which terminates posteriorly in a cul-de-sac, and an internal one which communicates with the nasal cavity proper.

In the duck, the vestibule communicates largely with that of the opposite side and has no turbinal. Its posterior limit is marked by an almost vertical fold of the external wall, which, narrowing the lumen at this level, forms the border of the orifice of communication between the two cavities. In the pigeon, there is a vestibular turbinal which is situated exactly under the supero-internal angle of the vestibule.

The nasal cavity proper in the turkey, duck and pigeon is narrowed by the projection of the two turbinals. They are both inserted on the external wall. The anterior turbinal, which is the middle turbinal in the turkey and in all birds which have a vestibular turbinal, has an elongated form and presents a round contour vertically and extends from before backwards and slightly from above downwards. It has an enlarged anterior extremity, and a slender posterior extremity; its free border is thick and round in the turkey, in which this turbinal has a large base of insertion (Fig. 17). In the pigeon, on the contrary, the middle turbinal is a cartilaginous lamina, slightly curled from above downwards and from within outward, with a thin pedicle and with a free border of slight thickness looking internally and inferiorly (Fig. 18).

The superior turbinal is a globular ridge placed in the neighborhood of the nasal roof and the posterior part of the cavity.

A large space, in the form of a fossa opening internally, is found between the middle turbinal and the nasal floor. A simple groove lies between the superior and the middle turbinals. Only the two turbinals of the nasal cavity proper belong to the olfactory organ. The vestibular turbinal is independent (Gegenbaur), and we have seen that in certain birds it is absent. According to Gegenbaur (1873), there is a special arrangement in the head of the bird which separates the external nasal orifice from the interior. According to what we have seen in the turkey, it has the role of dividing the vestibule into two parts, an external cul-de-sac and a very narrow internal canal; it thus protects the entrance of the nasal cavity.

The middle turbinal is the equivalent of the inferior turbinal or maxillary turbinal of mammals (Gegenbaur). This

opinion is based on the insertion of this turbinal at the level of the superior maxilla and above the opening of the lachrymal canal. Its high insertion upon the external wall does not correspond to the insertion of the maxillary or inferior turbinals of mammals. It has no relation with the maxillary bone, since it is the cartilaginous capsule which supplies it,

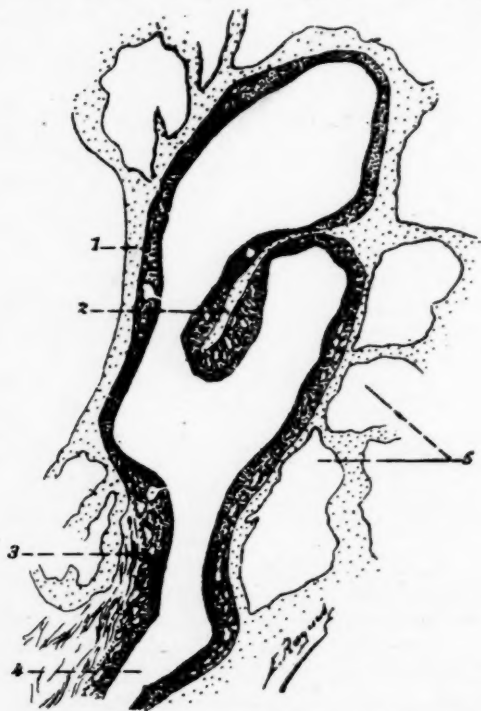


Fig. 18—X 34.3. Pigeon (transverse section of the nasal cavity, passing through the middle portion) (left side). 1. Septum; 2. Middle turbinal; 3. Chorionic glands; 4. Palatal fissure (choanal cleft); 5. Pneumatic spaces.

but its base is in relation with the lateral spaces which correspond to the sinus maxillaris. The superior or posterior turbinal corresponds to the first olfactory cushion of mammals. Mihalkovics homologizes it with the single turbinal of the saurians. According to Gegenbaur, there is in birds no

homologue of the ethmo-turbinal, besides, the superior turbinal is not, in his opinion, a true turbinal, and he compares it to the pseudo-turbinal of the crocodile. The superior turbinal of the vulture, through its insertion in the supero-internal angle of the nasal cavity, appears to correspond to the ethmoidal turbinal.

The nasal region is surrounded by numerous, extensive, pneumatic cavities, attaining in this respect a high degree of development. These different spaces may well be studied in transverse sections of the head of a pigeon. They are divided into two groups, an inferior and external group corresponding to the maxillary sinus, and a superior and internal corresponding to the frontal sinus.

Figure 18, representing a transverse section in the middle region of the nasal cavity, shows large lacunae external to this cavity, extending along the whole of the external wall, separated from one another by cartilaginous or fibrous septa.

They are either quadrilateral or round. Internally they are limited by the nasal capsule; externally by the fibrous tissue formed by the condensation of the deepest layers of subcutaneous connective tissue. In more anterior sections there appears a space, prolonged into the palate, limited by cartilaginous walls on all sides. This inferior space represents the palatal sinus, reported by Mihalkovics, the lateral spaces corresponding to a true sinus maxillaris. At the level of the base of the septum, below the intermaxillary and the nasal bones, the cartilaginous septum bounds a triangular space with base posterior, just where it unites with the opposite side.

At a more posterior level, this space is enlarged and is subdivided by cartilaginous lamellae. Extending posteriorly very far between the orbits, is a frontal sinus corresponding to the sinus orbitalis of Mihalkovics. The end of the septum widens into the shape of a playing-card heart, containing hollow cavities in the inferior extremity of the septal cartilage.

The direct relations between the different cavities and the nasal fossae are not visible; it shows, simply, the phenomenon of pneumatization so greatly diffused in the skeletons of birds.

NASAL SKELETON.—The cavity is surrounded above, externally and below by a cartilaginous wall which gives rise to the turbinals. It is thick and resisting, interrupted below by the palatal fissure; within, the cartilaginous capsule forms, in

connection with that of the opposite side, a lamina which becomes the septal cartilage.

This cartilaginous capsule is lodged in a bony space of the facial walls, where the bones are reduced to long pieces and can constitute only an imperfect protective investment.

In the turkey, the nasal skeleton is constituted above by the intermaxillary and nasal, below by the superior maxillary and

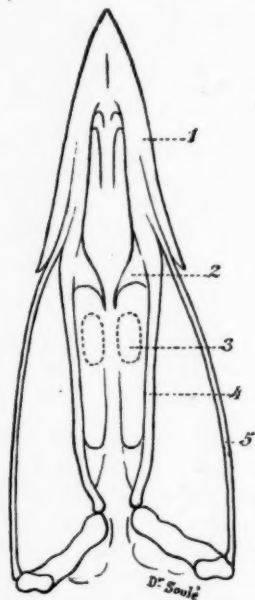


Fig. 19. Natural size. Turkey (skull seen from the inferior surface; the dotted lines indicate the position of the choana). 1. Superior maxillary; 2. Palatal process of the superior maxillary; 3. Choana in the fresh state (Schematic representation); 4. Palatal; 5. Jugal.

palate, externally by a part of the nasal and a part of the maxillary; internally by the septal cartilage (Fig. 19).

Intermaxillary.—Single, narrow, long bone which forms the median part of the superior surface and the point of the beak. A slight median groove indicates the division of the bone into two halves. The enlarged anterior extremity articulates with the superior maxillary, while its median part is

pointed. The posterior extremity is placed between the two nasal bones and comes in contact with the anterior border of the two front. The inferior surface belongs to the roof of the nasal fossae.

Maxillary.—Double complex bone of quadrilateral form. The external surface, slightly convex and smooth, is oblique from above downwards and from within outwards. The inferior surface is hollowed out by an antero-posterior fossa. The anterior extremity articulates with the intermaxillary. The posterior extremity presents three prolongations, an external portion which is continuous with the external portion of the inferior surface, a middle, very slender, which articulates with the os jugal behind, an internal one, large and flat, directed obliquely backwards and inwards, placed in a horizontal plane—the palatal prolongation.

Nasal.—Double bone, situated on each side of the intermaxillary, anterior to the frontal and internal to the lachrymal. It is large, flat and of quadrangular form; the superior surface is placed almost horizontal and is slightly hollowed out in the middle. Its inferior surface is concave transversely. The internal rectangular border articulates with the intermaxillary. The anterior concave border limits a large space filled with fibrous tissue. The posterior convex border articulates with the frontal, the external border with the lachrymal. The antero-external angle of this bone is prolonged into a long process which descends almost vertically to meet the maxillary. It constitutes the only bony part of the external nasal wall.

Palate.—Double bone, very slender, very long, passing horizontally from the posterior extremity of the maxillary to the pterygoid. The septal cartilage takes the place of the vomer. There is no bony turbinal.

In the vulture, the bones are more extensive. The anterior space between the nasal, intermaxillary and maxillary is partially filled with osseous laminae belonging to the maxillary. The palate is a large bone which forms a large part of the nasal floor. The turbinals are bony; the vestibular turbinal is a simple crochet inserted on the superior surface; the middle turbinal, inserted upon the external surface, is very voluminous, composed of the lamellae which are enlarged, perforated with numerous orifices, giving access to the air cavities; the superior turbinal, which is placed upon the most internal portion of the surface, is composed of a lamella rolled once upon itself.

In birds with a long beak, it is the anterior part of the nasal fossae, the vestibule, which is modified. The intermaxillary and maxillary bones are greatly elongated, and the nasal space which they surround is increased in length; the other bones and the principal nasal cavity do not present any essential modifications.

Parker (1869), in his study of the development of the cranium of the cock, shows the evolution, form and connections of the different bones. They are arranged in the same manner as in the turkey. The numerous figures which accompany this work are of great interest.

NASAL MUCOSA.—Throughout the vestibule and upon the vestibular turbinal, the mucosa presents a connective tissue corium and a stratified pavement epithelium having all the characteristics of epidermis, with the superficial layers strongly flattened and refractive. It is very thick over the turbinal and in the neighborhood of the external nasal orifice. The turbinal contains no cartilaginous lamina; but connective tissue and numerous vessels are present.

In the principal nasal cavity, the mucosa has the respiratory characteristics over the greatest portion of its surface; the olfactory part is limited to the nasal roof and the superior turbinal.

Over the middle turbinal is found an investment of the respiratory type, characterized by a cylindrical, ciliated epithelium and numerous depressions covered with clear cylindrical cells, as well as a great number of glands in the corium. In a section made in the middle portion of the cavity, the entire mucosa, except that of the roof, shows a considerable thickness of the chorionic layer, which contains a large number of glands. It may be said that the corium is formed by glandular tubes. They are held tightly together by one another, and the interspaces, occupied by fine connective tissue septa holding blood vessels, are very narrow. Towards the inferior border of the septum, the thickness of this glandular layer is 178 mikra. Some of these glandular tubes attain great dimensions. There are also numerous crypts, simple depressions of the epithelial surface, opening largely into the nasal cavity. Every portion of the nasal cavity possesses this richness of glands. It is most remarkable in the inferior portion of the septum and throughout the middle turbinate, with the exception of its inferior surface. The epithelial cells, which line the glandular tubes, are cylindrical and elongated. They present a

base larger than the central extremity. The basal portion contains the nucleus and some strongly colored granules; it occupies almost a third of the cell. The other portion is clear, very refractive and without visible granules. In certain cul-de-sacs, the entire height of the cell presents refractive characteristics, due to the mucous glands.

Their presence gives to the mucosa a special respiratory character; the secretion must be abundant to keep moist a membrane which is subjected to very intense dryness while on flight. The epithelium of the surface is formed of high cylindrical cells, with a deep extremity containing the nucleus, intermingled with round elements, and a central extremity with finely granular and clear contents, limited towards the cavity by a granular border which is prolonged into very short cilia outside of the cell.

Glands are uncommon at the level of the nasal roof and the adjoining internal and external walls. The epithelium presents several layers of round cells lying close to one another, and a superficial layer of cylindrical cells. Max Schultze describes olfactory cells in birds, analogous to those in amphibia and reptiles, possessing tufts of long cilia and cylindrical non-ciliated epithelial cells.

In the air cavities we have not found a mucous investment covering the cartilaginous or fibrous walls.

Besides the numerous glands included in the corium of the respiratory mucosa, there are glandular masses in the neighborhood of the nasal cavity.

In the vestibular region, a group of cul-de-sacs is found between the two cavities, near the buccal roof, which are glands belonging to the buccal cavity.

Towards the anterior extremity of the principal cavity, glandular tubes are seen, on transverse section, placed some above and some below the palatal and maxillary sinuses. The inferior group continues posteriorly along the external lip of the palatal fissure. The superior group (external nasal gland), which increases in importance at a more posterior level, is placed opposite the line of insertion of the middle turbinal, then disappears at about its middle portion. Some glandular tubes are found in the posterior region, external to the frontal sinus above the nasal roof.

These glands have a deep cubical epithelium, with a nucleus in the middle portion of the cell, with a clear, finely granular zone within. They are serous in character.

Most birds possess a special glandular apparatus, studied by Cuvier, Tiedemann and Jacobson. Nistch describes it under the name of nasal gland. Jobert (1869) made a very complete study of it in 1869. He made observations on the waders and the palmipeds. The gland is located in a hollow fossa in the frontal which limits it posteriorly and laterally, while the lachrymal bounds it anteriorly. The excretory duct discovered by Jacobson, then by Nistch, is double according to Jobert. The two excretory ducts, formed of long, laminated fibres, are directed from above downwards and from behind forwards; the superior passes under the nasal bone and opens at the superior and external portion of the nose. The other, deflected, descends behind the nasal and opens on the internal surface of the nose in the middle meatus.

According to Müller, all the glands of the nose have the same structure as the salivary glands. Jobert accepts this view for the nasal gland.

This gland has been considered by Cuvier and Nistch as a lachrymal gland; according to Tiedemann, it secretes an oily liquid and it is on this account well developed in birds which live in the water or on the shore.

No glands below the corium are found in the interior of the septum. It contains only connective tissue and the vessels of each side of the cartilaginous axis. There is no trace, in the pigeon, of invagination of the mucosa, nor of an isolated tube which might represent an organ of Jacobson. Ganin and Mihalkovics have described an invagination of the mucosa in the septum at the level of the anterior extremity of the middle turbinal which, in certain transverse sections, is isolated and closed in the form of a tube. According to their view this represents an organ of Jacobson. Mihalkovics compares this formation with the canal of Jacobson in the human fetus. There is evidently a great resemblance between them.

Birds form an aberrant group between saurians and mammals which possess a well-developed organ of Jacobson. The absence of the organ coincides, in these, with a greatly reduced olfactory sense. Whether or not this organ has the function of exercising a sensory control upon the contents of the buccal cavity, it is found largely replaced by olfactory epithelium itself, which is directly affected by virtue of the communication established between the buccal and nasal cavities by the long palatal fissure.

(To be continued in the June number.)

II.

REMARKS ON THE MACROSCOPIC DIAGNOSIS AND GENERAL INDICATIONS FOR TREATMENT OF CANCER OF THE LARYNX.*

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There is no chapter in the book of laryngology that needs more careful revision than the chapter on cancer of the upper air passages. Indeed, it will have to be entirely rewritten. We are passing through a crisis in the history of this subject in which the same old battle is being fought that has raged around every other organ of the body where cancer dwells. Here, as elsewhere, we have much to learn, much to unlearn.

In responding to your courteous invitation to take part in this symposium I think I can perhaps best utilize the limited time (twenty minutes) which has been placed at my disposal by calling attention as briefly as possible to two phases of the problem of cancer in the larynx, which, in view of the unsettled state of the question, seem to me of most pressing and immediate importance.

In the present state of our knowledge there are three principal methods of diagnosis in laryngeal cancer. These are, in the order of their practical usefulness and importance: 1. The naked-eye method, or diagnosis by direct inspection, supplemented by clinical phenomena. 2. Thyrotomy. 3. The microscope. Of the three methods the second is often included in, and therefore ancillary to, the first. Take it all in all, the first method is by far the most practicable and satisfactory of the three. I shall consider briefly only one of its different phases.

For some time past, inspired by the work in the surgical department of the Johns Hopkins Hospital and guided

*Remarks made in a Symposium on Cancer, held at the New York Academy of Medicine, October 19, 1905, at the Twenty-second Annual Meeting of the New York State Medical Association.

by my own personal observation in the matter, I have become more and more impressed with the possibilities of naked-eye inspection, or macroscopic diagnosis, in malignant disease of the upper air passages. Although for a long time entertaining strong convictions on the subject, I first gave definite and public expression to them in some remarks made at the opening of the debate on "Cancer of the Larynx" at the Congress of the American Laryngological Association held in the city of Washington in 1900. My object then, as it is now, was to stimulate study in the direction of the macroscopic diagnosis and pathology of laryngeal growths, and the examination of the fresh specimen or material with the naked eye.

Much has already been accomplished by this method in the field of advanced surgical pathology, so that the general surgeon is to-day coming less and less to rely upon the pure pathologist for diagnosis, and to seek the aid of the microscope, except as a court of the very last resort. To use the words of Bloodgood, who has done most excellent and painstaking work in this field, the surgeon must, in the majority of cases, make the correct diagnosis of tumors, "not on the clinical history and examination, but in all those cases which are not clinically positive, he must base his diagnosis on the naked-eye appearance of the diseased tissue, exposed by the knife at the exploratory operation."¹ This observer, in a careful analysis of over 1300 cases of tumor in Halsted's clinic at the Johns Hopkins Hospital (in which the benign stood to the malignant in the proportion of 1 to 3), comes to the conclusion that it is possible, in the majority of cases, to recognize the character of the growth by the naked-eye appearance alone. From this study, also, it is shown that it is not only possible, as a rule, to differentiate the benign tumors from the malignant at the exploratory incision, but to recognize in the malignant the different groups of varying malignancy, and in the benign, growths which have a tendency to become malignant.

In Halsted's clinic at the Johns Hopkins Hospital more reliance is placed on the naked-eye diagnosis than on the frozen section. It is claimed that even with the use of recent improved methods of preparing the latter, the naked-eye method furnishes more accurate diagnostic information; and although the frozen section undoubtedly holds its own as a most valuable means of diagnosis, still it is often misleading and more con-

(1) *International Clinics*, 1904, fourteenth series, vol. 1, p. 237.

fusing than the macroscopic image of the cut surface.

It is difficult, if not impossible, to satisfactorily depict the macroscopic appearances of tumors by means of language. A's description would be perfectly unintelligible to B, B's account would have little or no meaning for C, while C's picture would be utterly bewildering to D — and so on to the end of the alphabet. I cannot possibly emphasize this point better than by quoting the words of Halsted in his illuminating address on the "Training of the Surgeon," delivered last year at Yale.¹ "I am sure that much of the material for surgical pathology can be correctly described only when it is perfectly fresh. It cannot be painted, because in less than a minute, in a few seconds often, the appearance of a freshly cut surface is greatly changed. Only those who are well trained as macroscopic pathologists, who have naturally a discriminating eye for color, a good sense for form, and some talent for expression can properly describe the fresh material. Many, if not most, of the descriptions are worthless or at best serve only as reminders to those who can distinctly recall the case. The descriptions, by two trained men, of ordinary fresh material may differ so greatly, that one could not believe they pertained to the same specimen. Color photography might be employed, it seems to me, with great benefit, for recording the appearance of fresh specimens."

I cannot insist too strongly on the application of the naked-eye method of diagnosis in the case of malignant tumors of the larynx. Every resource and refinement of clinical diagnosis, including the exclusion of syphilis by the iodides and tuberculosis by tuberculin, should be resorted to before an appeal to the microscope is made. By following the lead of the general surgeon, with the means of clinical diagnosis already at our command, together with more exact information concerning the naked-eye appearances of the cut surface of laryngeal neoplasms, we will soon be in a position where we will be more and more independent of the pure pathologist for help in diagnosis.

Every tumor of the larynx, no matter how benign it may appear, should be examined with the greatest possible care. Some of the most fatal diseases known to man make their first appearance in the larynx in the guise of great benignity. Thus the presence of cancer and tuberculosis in the individual is often first proclaimed by the discovery of an apparently simple papil-

(1) Bulletin of the Johns Hopkins Hospital, Sept., 1904.

lomatous excrescence in the larynx. By the careful study of *every* case coming under our observation, we will some day, among other things, clear up the mystery which surrounds the genesis of papilloma and approach more closely the earliest possible recognition of some of the most deadly diseases of the larynx.

This brings me to the consideration of the question of the partial extirpation of laryngeal cancer for microscopic diagnosis.

The objections which I have repeatedly urged against the indiscriminate removal of tissue for examination (especially when done through the natural passages) are as follows: 1. It subjects the patient to the danger of antoinfection at the point of incision and to metastasis elsewhere. 2. It stimulates the local growth of the cancer. 3. Finally, the method is often inconclusive, misleading, and sometimes practically impossible.

The moment the continuity of the growth is broken, in that moment is opened the pathway for self-poisoning, and an unfavorable influence is excited on the local process. If ulceration has already taken place, a portion of the growth can be taken, if skilfully removed, for microscopic examination; but, as Bloodgood has pointed out, in the majority of cases the tumor is "buried" and an exploratory incision for purposes of microscopic diagnosis means two operations, and if the tumor is malignant, opens the way for general dissemination.

If I interpret aright the general sentiment of those laryngologists who are qualified to speak with authority on the subject, and who have declared themselves on this phase of the question, it is practically to the effect that attempts at incomplete removal (whether for diagnostic or curative purposes) of malignant growths of the larynx have little or no irritating or stimulating effect upon the local disease. In view of the established and glaring fact that the growth of cancer elsewhere in the body is stirred into greater activity by incautious manipulation of the local lesion, it seems well nigh incredible that any disagreement of opinion in the matter should exist in the case of cancer of the larynx. And yet, strange as it may seem from the standpoint of the modern conception of cancer, the universal sentiment of authority is to-day practically unanimous in advising indiscriminate and immediate removal of portions of a suspected laryngeal neoplasm as an early

and routine means of diagnosis. Even the best of laryngeal surgeons lose no time in procuring pieces of a supposed cancerous growth of the larynx for examination under the microscope, before they have gone carefully into the history of the case and endeavored to make the diagnosis with the naked eye alone. In the light of my own experience, I do not hesitate to declare that cancer in the larynx behaves in precisely the same way under incautious irritation or manipulation as it does in other organs of the body. Not to multiply examples, I well remember the method of treatment of laryngeal cancer in my earlier days (at the Golden Square Hospital, London), which consisted in the performance of tracheotomy and the subsequent removal, piecemeal, of the growth through the natural passages. By this process, which to-day in enlightened surgical communities would be considered as a means of slow murder, the growth was stimulated at once into much greater activity, the patient naturally became worse and worse, and was sent to his long home much earlier than if he had been left severely alone. As I have said on another occasion, when I look back through the years in which I have seen cancer of the larynx maltreated, and in which I have unconsciously maltreated it myself, I am simply appalled at the retrospection.

I am sorry, too, that my personal experience does not agree with that of some of my laryngological friends who deny the possible dangers of autoinoculation and metastasis after incomplete attempts at the removal of laryngeal cancer. The position, it seems to me, is axiomatic and does not call for debate. If all the cases of metastases following incautious operations on laryngeal cancer were to be placed on record, their number would appear in the form of a revelation. Such cases do not usually find their way into print.

And just here let me say if any one wishes to know in what sense I use the term metastasis, let him consult the nearest medical dictionary for a definition of the term. To charge, at least by innuendo, as one of my critics has done, that by "metastasis" I mean the inhalation into the lungs or the deglutition into the stomach of detached fragments of the growth is simply unmitigated nonsense.

As to the question of direct inoculation of the laryngeal tissue by constant contact of opposing broken or unbroken surfaces, I can only say that, while not denying the possibility of its existence in cases in which the foul discharge from the can-

cerous mass may come in contact with an abraded or ulcerated surface, I have never met with an authenticated case of the kind in literature, nor have I ever seen this accident in practice. Such a phenomenon is common and characteristic and of important diagnostic significance in tuberculosis; in cancer of the larynx, its occurrence is as yet unknown and problematical. To confound such a phenomenon with the phenomenon of metastasis, however, with which it has nothing in common and to which it bears no resemblance, would be an inconceivable blunder had it not already been committed.

An interesting fact in connection with this part of the subject is the great difference in the tendency to metastasis after cauterization and after incision of cancerous tissue. In the former (when done, for example, by fire or escharotic), while metastasis may and does occur, there seems to be only a slight tendency to dissemination, while on the other hand, when the knife is used, metastasis is almost sure to follow. Thus, out of hundreds of cases of breast cancer in Halsted's clinic, not a solitary patient has been cured in whom the tumor had been previously incised or operated upon by surgeons outside of the hospital. There have been several in which a cure has been effected after recurrence, the original operation having been done in the hospital, but not a single case of cure in which the patient was operated on before entering the institution.

I need not dilate upon the difficulties in the way of the microscopic diagnosis of cancer of the larynx. They are multitudinous. That the very best pathologists make mistakes (especially in the diagnosis of tumors) is a matter of common observation. The surgeon, through no fault of his (and even the pathologist), may be easily misled and therefore only such testimony should be accepted as final as comes from an expert specially versed in the histological differentiation of tumors.

In closing this part of my subject, permit me to correct a wrong impression that seems to have been created in the minds of some of my colleagues both at home and abroad as to my views on microscopic evidence in the diagnosis of suspicious looking neoplasms of the larynx. According to my critics, I reject completely the use of the microscopic in the diagnosis of malignant growths of the larynx, and therefore would recommend the complete operation for that disease in the presence of doubt as to its nature. As one of them puts it, I "kick the microscope into the dust heap." No one but a congenital fool would

refuse in doubtful cases the aid of the microscope, and no one outside of the asylum would advise a radical operation (such as the one suggested by me) without a certainty of diagnosis. There are some things that go without saying and which ought to be obvious to the dullest apprehension, and I cannot think that any one who knows me can believe me guilty of such insanity. My original remarks made in 1900, which have called forth such a storm of abuse and misrepresentation, dealt in general principles of diagnosis, and no attempt at elaboration or specification was made. My position, as then stated, is simply that the microscope should be the court of last resort—the final method of appeal. Hands off the growth until the last. Then, if microscopic examination is necessary, let patient and surgeon be prepared for immediate operation. As I said on the occasion already referred to, “before resorting to thyrotomy in general, especially if a portion of the growth is to be removed for examination, it should be clearly understood beforehand with the patient that, if the disease should prove to be cancerous, the surgeon shall be at liberty, if in his judgment it seems best, to proceed at once to operation.” I took this stand in order to check, if possible, the reckless and indiscriminate removal by laryngologists of suspected tumors of the larynx for microscopic examination, and from what I hear and read I may be pardoned if I say that the warning has not been given in vain.

What the future has in store for the treatment of cancer can only be a matter of conjecture. Serum therapy will doubtless some day play a conspicuous part in the treatment of this disease. For surgical treatment to be sufficiently radical involves the sacrifice of so much tissue that the time must surely come when surgery will be supplanted by simpler and more certain means; and with the discovery of the agent of infection will come its antidote. But with the possible future discovery of a serum, with perhaps the ultimate development of the fact that cancer is due to chemical changes in the blood, and therefore beyond the reach and uninfluenced by surgical procedure—with these and other possibilities we are not as yet confronted. The knife is our only weapon today. How can we best employ it?

I do not propose, nor have I the time, to go into any unprofitable discussion of the relative merits of the various operations done for laryngeal cancer, but will simply ask attention

in a general way to the chief indications for and the nature of the operation to be performed for that disease. The indications for operation may be conveniently considered under three principal heads, viz.: (1) the size, (2) the situation and extent, and finally (3) the character of the growth.

1. *Character.* Of these, the latter is by far the most important, and its discussion brings us to the consideration of an immensely important phase of the question, viz., the possibility that the rapidity and certainty of metastasis in laryngeal cancer probably depends not so much upon the situation or even size of the growth as upon its character. In other parts of the organism, some forms of cancer, as is well known, tend to form metastasis quicker than others; in other forms metastasis takes place at a much later period. Examples of the first class are the "spined-cell" tumors, and of the second the group of basal-cell growths. It is very possible that this is true in regard to tumors of the larynx, and that there are in this organ forms of carcinoma of varying degrees of malignancy and with marked difference in their tendency to metastasis. If, then, in the future evolution of our special knowledge along these lines, it shall be indisputably shown, by specially directed study and observation, that some laryngeal cancers are clinically more malignant than others, and that, on the other hand, there are some hitherto thought to be specially malignant which for all surgical purposes are practically benign; then in considering the indication for and character of the operation to be performed, the two conditions of size and situation of the neoplasm become matters of relatively secondary importance.

2. *Size.* A specially malignant type of growth (such as, for example, a scirrhus or medullary cancer), no matter what its size or appearance, no matter whether it is situated inside the larynx or outside the larynx, would demand the most drastic surgical procedure, while in the case of a less malignant and dangerous tumor (as for example the basal-cell cancer) a less radical operation might possibly be called for.

Laryngologists have heretofore committed the common error of grouping together in one class all malignant and quasimalignant laryngeal growths, without making those finer histological distinctions which are so necessary to the proper conception of the relative malignancy of the tumor and the manner of its removal. This finer anatomical differentiation of malignant larynx tumors is a fertile field for future laryngological

study and research. The uncertain or quasimalignancy of some tumors may possibly furnish the explanation of non-recurrence after incomplete removal of the laryngeal structures.

3. *Situation.* I do not believe that any other than the most radical operation should be undertaken in cases in which the disease is medianly situated (as for example, at the anterior commissure or on the posterior wall of the larynx), or in which it occupies both sides of the larynx, or in which, being unilaterally situated, it approaches at all closely the middle line. Equally hazardous would be an incomplete operation in cases in which the disease appears as a diffuse infiltration, especially if fixation has occurred (no matter where situated or to what extent the larynx is visibly involved).

I may say, in passing, that whatever may be thought of other incomplete operations for the cure of laryngeal cancer, there are two methods of procedure which in future narratives of this disorder will be referred to as matters of purely historical interest — the operation through the natural passages and subhyoid pharyngotomy.

It is amazing what a hold the intralaryngeal operation still retains on the minds of some of the world's best laryngologists. It is a curious fact that the practice of removing malignant neoplasms of the larynx through the mouth obtains in intelligent quarters even at the present day. And yet the operators who resort to it are simply following the lead of some of the most prominent laryngologists all over the civilized globe. High authority not only sanctions but adopts it as an unquestioned method of treatment. Even in Germany it still has its supporters. The author of the chapter on malignant growths of the larynx, in Heymann's *Handbook*, not only advocates it, but also recommends (at least in the early stages of cancer) the endalaryngeal method, devoting seven pages to its consideration and only two to the more radical measures. While I am quite willing to admire and applaud the skill with which some of these operations are performed, nevertheless, for reasons which I have repeatedly given elsewhere, I cannot too emphatically condemn such a method of procedure. No amount of skilful endalaryngeal manipulation should justify or palliate such an uncertain and perilous operation, especially (for obvious reasons) when the growth is situated in the infraglottic region. Removal of cancer of the larynx by the endalaryngeal method, therefore, should never

come within the range of serious consideration. The risks, even in the earliest cases, are too many and too great. It is a dangerous game in which both surgeon and patient take the gambler's chance.

The same thing may be said of subhyoid pharyngotomy. The number of cases in which it would be even indicated is excessively small, while the risks of the operation far outweigh any advantage to be gained by its performance.

In approaching the treatment of laryngeal cancer we have to face the following facts:

1. It is impossible to limit the extent of the disease laryngoscopically.

2. It is often equally impossible, even after preliminary division of the thyroid, to map out with certainty the whole area occupied by the disease. This is especially true in the case of diffuse infiltration, or where the epithelioma originates in the deep-seated tissues and does not approach the surface until a late stage of the disease.

The loose tissue beneath the mucous membrane in many places, and its wealth in lymphatics, often favor, from a small focus of infection, infiltration of and crossing to other portions of the larynx, and sometimes with great rapidity. Diffuse infiltration, especially if there be fixation of the parts, even though confined to a small area, should always awaken suspicion of the existence of the disease elsewhere in the organ, even though no apparent signs of its presence exist.

3. Even after the removal of the entire larynx, the disease may be apparent in one side of the organ and not in the other, and yet the microscope show extensive carcinomatous deposit in the seemingly normal side. We can never be sure, even in cases in which the cancer appears to be distinctly circumscribed, whether dissemination in other parts of the larynx has not taken place.

4. Cancer in the larynx grows with greater rapidity than it does in other regions of the body. This is due not alone to the histological structure of the organ, but also, and chiefly, to the fact that its physiological mechanism is in ceaseless operation.

5. Investigations, in the study of cancer in other parts of the body, have developed the fact that the amount of lymphatic involvement bears no definite relation to the size and extent of the local lesion. Thus, a small local focus of infection may

be attended with most extensive metastasis to the glandular adnexa; while, on the other hand, the latter may not be markedly involved even in extensive invasion of the primary disease. One or two illustrations will suffice. It has been shown, for example (Wertheim,¹ Sampson²), that in the case of cancer of the uterus, there is no relation between the size of the primary growth and the presence or absence of involvement of the pelvic lymphatic glands, and that we can never, therefore, tell clinically whether or not metastasis has taken place. And to come nearer to our subject, a notable example of the disproportion between the size and extent of the local lesion and the lymphatic involvement is furnished in the case of the lip. Not infrequently cases are brought to the surgical clinic, in which masses of enormously enlarged neck glands have been removed under the impression that the condition was the original disease, when, as a matter of fact, a small unnoticed inconspicuous abrasion or ulcer of the lip has been the primary focus of infection.

These are facts not only of great practical prognostic significance, but also, if shown to apply to the larynx and its lymphatic supply, of overwhelming importance in the surgical treatment of cancer occurring in that organ. It will be the task of the future to determine whether in more or less advanced stages of this affection, or even in its earlier history, the disease may not already lurk in the neighboring lymphatics, as has been demonstrated in the case of cancer elsewhere in the body.

In practically all fatal cases of larynx cancer, death is due to metastasis. In neighboring organs (the neck and mouth) metastasis takes place with great certainty and at an early date. It is therefore, *a priori*, probable that the neck glands are affected in the case of cancer of the larynx, although perhaps not recognizable by the senses of sight and touch, at a much earlier period than is generally supposed. It is at all events safer to assume this to be the fact than to accept the statement, unsupported by definite anatomical proof, that cancer, in the interior of the larynx remains for a more or less indefinite period as a purely localized disease, and does not get into the neck lymphatics until a late stage of the affection.

This is a fundamentally important phase of the question

(1) Archiv. f. Gynäkologie, 1900. Bd. lxi. No. 3.

(2) Journal of the American Medical Association, October 29, 1904; Albany Medical Annals, May, 1905, etc.

upon which as yet little or no light has been shed. Until more exact knowledge concerning it be forthcoming, it behooves the surgeon to move with caution, even in cases in which the disease is apparently a distinctly localized affection. In the presence, therefore, of the fact that it is often impossible to limit the diseased area by inspection and the sense of touch, and in the light of the revelations of the microscope, it becomes a serious question whether we accomplish any lasting good, in the majority of cases at least, by any operation short of complete excision of the larynx and the neighboring lymphatics and glands.

On this subject, however, there is much honest difference of opinion. I am not here to discuss it. The whole question, as I have tried to indicate, resolves itself into two special lines of study, viz.: (1) the relative malignancy of tumors of the larynx, and (2) the determination of the glandular involvement in the case of various kinds of tumors as well as various situations of tumors. Investigation along these lines must determine largely the manner of future operative procedure. Whatever operation is done, it should be forever borne in mind that we are dealing with cancer; that no matter how minute the original lesion may be, the area of possible poisoning is practically boundless; and that if the slightest doubt exists as to the character and circumscription of the growth, the complete operation should be done.

Let us finally look forward to the day, which in my humble judgment has not yet arrived, when it shall be definitely shown beyond all human doubt that cancer of the larynx, taken in its earliest stages, while yet a purely localized affection, can be permanently cured by simple surgical measures; but in the meantime, in the present state of our knowledge at least, in view of the uncertainties which the problem before us presents, and in the light of the modern conception of the treatment of cancer, let the surgeon be prepared to take no chances, but in the forceful, if inelegant words of Gross, let him "cut out the very atmosphere of the damned thing."

III.

THE TREATMENT OF HYPERTROPHIC AND INTUMESCENT RHINITIS.*

PRELIMINARY REPORT.

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The treatment of chronic rhinitis of the hypertrophic and intumescent forms is a subject that has been frequently discussed. Nevertheless, it possesses sufficient interest to warrant one in making a clinical study of a definite number of cases in order to ascertain just what results have been obtained from a particular line of treatment. A detailed study of the results of cauterization with the galvano-cautery in these cases has only confirmed us in the belief that this operation, when properly performed, offers the most satisfactory method in the treatment of these conditions.

The use of the galvano-cautery in the treatment of the ordinary forms of so-called nasal catarrh, has to some degree given way to the snare, scissors, or the local application of medical agents. Some rhinologists have condemned it on account of a supposed liability in causing ear complications. For various additional reasons, others have laid it aside. Probably some of the same factors that entered into bringing into disrepute chemical cauterizations, have affected similarly galvano-cauterizations, although a comparison of the two methods, in our opinion, shows that the latter is more easily controlled and produces more lasting results, without destroying large areas of mucous membrane. Not only can a greater length of the turbinal body be safely cauterized at one sitting, but the cauterization can be made deeper and more effective and can be accurately limited to the region desired. The snare and scissors without question have their place in the treatment of these nasal conditions, but

*Read at the Middle Section of the American Laryngological, Rhinological and Otological Society, Feb. 24, 1906.

the indication for their use is less frequent. Naturally where the hypertrophy is of great extent or confined to the posterior ends of the turbinals, these would be the instruments of selection. In the intumescent forms of the disease, the galvano-cautery is superior, as it destroys only a small part of the turbinal tissue, and as the wound heals a contraction down to the bone is brought about which prevents subsequent swelling. It is easy to remove too much tissue and bring on an apparent atrophic condition, as may be done with a too free use of the snare. The use of local remedies, such as astringents, while sometimes affording temporary relief, have not impressed us with the permanency of their results.

In order to show the value of the galvano-cautery, in the usual cases of catarrh, one hundred consecutive records, in which treatment had been carried sufficiently far to serve as a basis for comparison, were taken, comprising fifty of the hypertrophic form and fifty of the intumescent. The records were of patients, the majority of whom were first seen from three to five years ago. This was done in order to be sure that sufficient time had elapsed from the beginning and end of treatment to obviate any doubt as to the permanency of the results. No case in which there had been less than two cauterizations was taken, although not infrequently patients experience relief from one operation, yet many for various reasons do not return for further treatment.

In a careful study of the 100 cases, the causes of complaint were found to be exceedingly variable, but in the main, the symptoms for which treatment was instituted ranged from a feeling of stuffiness in the nose, stopping up or occlusion of one side alternately with the other, or of both sides at the same time, to permanent obstruction complete or incomplete of one or both sides. Along with these conditions were sensations of dryness in the nose, pain usually referred to the root of the nose, dropping back of mucus into the nasopharynx, or excess of secretion in the nose without any discoverable indication of sinus disease. Headaches, impairment of the sense of smell, sneezing and a history of catching cold easily were also noted as troublesome symptoms. Gastro-intestinal disturbances were present in some instances. Some also presented certain symptoms referable to an associated catarrhal condition of the ears, such as a sense of fullness, tinnitus and more or less loss of hearing. Symptoms of pharyngitis or laryngitis were noted in a consid-

erable number of cases, due to a transient or persistent habit of mouth-breathing.

The duration of the nasal affection was variously stated. Some patients give a history of having been troubled always, the shortest time was three weeks. The greater number had been affected from one to six years.

The nasal conditions for which cauterizations were undertaken have varied from an obstruction of approximately one-fourth the lumen of the naris to complete closure of the same, embracing, of course, the simple intumescent or intermittent forms and those of the chronic or hypertrophic form, circumscribed or general, with partial or complete permanent obstruction. In many instances definite statements were given by the patients as to the ability or inability to breathe freely through the nose, in whom at the time of the examination the reverse conditions were present.

In a number of cases, exostoses of greater or less degree were present, necessitating removal before an entirely satisfactory result could be obtained; but in the majority, the results were satisfactory without any septal operation. We never recommend this operation unless sure that the condition of the septum causes decided obstruction to nasal respiration. Where the hypertrophy of the posterior end of the turbinal body was great, the snare was employed.

In the hypertrophic form one or the other side was free at the first examination in fourteen cases. Swelling was found on only one side in twelve instances, but both sides were involved in 33 of this series.

In the intumescent form, at the first examination, one or the other side was free in 18 and both sides in 3 cases. Swelling was present on only one side in 28 and in both nares in 15 of the patients.

The inferior turbinal bones were enlarged in two, and the posterior ends of the turbinal bodies were considerably enlarged in four cases.

Exostoses of the septum were noted in one or the other side in the hypertrophic form in 20 cases. Swelling of the septum occurred in both sides three times and in either side alone, eight times. Simple deflection was found in one case and deflection and exostoses in four.

In the intumescent form exostoses were present in one side 19 times and in both sides 3 times. Swelling of the septum

occurred on both sides 3 times, in one side 3 times. Deflection occurred twice and deflection and exostosis the same number of times. Out of the 100 cases the septum was involved in 51, exclusive of those in which merely swelling was noted. Adhesions and perforation were each found once.

The middle turbinal showed changes such as hypertrophy, swelling or polypoid degeneration in only 17 instances and these changes were confined to one side. Polypi were found in five cases. Submucous thickening at the sides and base of the vomer was noted six times. Hyperesthesia was found three times and in four cases the mucous membrane was noted as paler than normal.

METHOD OF CAUTERIZATION.

The first step in preparing the naris for cauterization is the removal of any secretion that may be present, after which the turbinal body is anesthetised with a four per cent solution of cocain, containing in addition, the following ingredients: Atropin gr. 1-10, strophanthin gr. 1-5, ol. caryophylli M. iii, acid carbolic grs. x to aqua dest. oz. 1 and methylene blue, sufficient to color the solution a light blue. This solution is applied by means of a cotton-wound flat applicator which is slowly rubbed backward and forward along the entire length of the turbinal, for from 20 to 30 seconds. From three to five such applications are ordinarily necessary to complete the anesthesia. In a few instances where a 4 per cent solution is not strong enough to produce anesthesia, a stronger solution must be used. Constitutional symptoms from the use of this 4 per cent solution are extremely rare. Where a patient has an idiosyncrasy to cocain, eucain or alypin is used.

The knife-like electrode is introduced and a linear cauterization is made extending the whole length of the inferior turbinate body, usually at the junction of the upper with the middle third, or of the middle with the lower third of the body. In an occasional case where the reaction from the cauterization has been too great, only one-third or one-half of a complete line is made at subsequent sittings. Following the cauterization an application of compound tincture of benzoin with an excess of two ounces of benzoin to each ounce of powder of iodol is applied to the burnt line, followed by a mild oily spray. This seems to lessen the chance of infection and also lessens

the reaction from cauterization. The patient is given an oily spray and a powder for home use and is directed to wear a pledget of cotton in the nostrils when out of doors for four or five days. He is told to return at the end of this time and a probe is passed between the turbinal body and septum in order to prevent an adhesion taking place. If everything is going well, he is then told to return in from ten days to two weeks, when another cauterization will be made upon the opposite side. Much discomfort is apt to be caused if a second cauterization is made before at least ten or twelve days have elapsed. In this time the nose, while not entirely healed, has recovered sufficiently to permit of a second operation.

In cauterizing the middle turbinal or septum, only short lines are made each time.

Altogether 295 cauterizations were made, 149 in the hypertrophic and 146 in the intumescent variety. The right inferior turbinal was cauterized 137 times, the left 143, the right side of the septum 12, the left once, and the right middle turbinal only two times.

It was necessary in 25 of the cases to perform other operations; which were 27 in number, viz., exostosis removed in 11, polypi in 4, adhesions cut in 2, resection of septum in 2, burr or trephine through turbinal bone in 5 cases, posterior ends snared off in 3 and tonsils removed in 1; of these 25 cases, nine had undergone some previous operation. In addition to these nine, ten more cases of the series had been operated previously. These operations consisted of removal of tonsils in five, of Luschka's tonsils in three, cauterizations in nine, removal of polypi in three, resection of septum in one, removal of spur in one and of part of turbinal in one. Several of these operations were combined in some of the cases.

Of complications or unfavorable conditions following the operation, bleeding was noted in seven instances. In no one of these cases, however, was it of any great importance, as it was not necessary to adopt any measures such as packing to stop the flow of blood. Attention is called to this merely to show that if sufficient care is used in having the electrode at the proper heat, bleeding can practically always be prevented. Only in those cases in which the wire is at too white a heat is there liable to be any trouble from this source. Adhesions were noted in five cases, but they were usually readily broken down by the use of a probe; this was sometimes followed by the application of a mild solution of silver nitrate.

When caution is used to avoid wounding the mucous membrane of the septum opposite to the point of cauterization and when the patient is seen again in four or five days, the liability to adhesion-formation is greatly diminished.

The use of a spray in the home treatment caused some trouble in seven instances. These patients complained of soreness of the nostril, sneezing, dryness, increased discharge or nausea. Headache, pain in the nose, or neuralgia, were complained of in a few cases following the cauterization. Several of these patients, on returning, spoke of having caught cold with the attendant symptoms of an acute rhinitis, a condition that should be anticipated after most intranasal operations. Tonsillitis occurred within one day after the cauterization in one case. Increased secretion was noted a few times, as was also a feeling of dryness in the nose. In one case the burnt area healed very slowly. Complete healing of the catarrhal condition, as a rule, takes place in from four to six weeks after the cauterizations have been completed, and after this time there is but rarely any complaint as to dryness, crusting or scabbing in the nose.

In no instance was there any aural disturbance or complication attributable to the cauterization, although we have observed such a complication in one instance in several thousand operations.

The shortest period of treatment was eight days; the longest was for two years. However, in this latter case the treatment was frequently interrupted for months at a time. Fourteen were treated for less than twenty-four days, sixty-three were treated for from one to six months, seventeen from this time up to one year, and seven over a year. However, it should be stated that in a considerable number of cases in which the treatment was prolonged, the patients were from out of the city and consequently the treatment was not continuous, it being largely a matter of convenience to the patient when he would return. Of the sixty-three who were under treatment from one to six months, the greater part were under care from one to three months. The average number of consultations in this latter division was about six.

In the average uncomplicated cases of hypertrophic or intumescent rhinitis, eight to ten weeks, with six to ten consultations all told, should be sufficient to effect a cure. Relief, however, may be obtained in less time, most patients noticing this in but a few days after the first cauterization.

The time elapsing between cauterizations varied greatly; this extended from eight days to 13½ months. No case was cauterized the second time before eight days had elapsed since the previous cauterization. The second cauterization was not made until after an interval of three months in sixteen cases. The greater majority of succeeding cauterizations were noted in from eight days to one month. More cauterizations took place after a lapse of fourteen days, than upon the lapse of any other period of time.

A second cauterization is rarely made before ten days have passed since the former one and it is only made then when some special exigency requires. Experience has shown that it is better to wait about fourteen days before undertaking another operation. While the nose is not entirely healed even at this time, it has so far recovered as not to cause the patient any serious inconvenience because the succeeding operation is made in the opposite naris. In some instances, especially when the general health is not up to the normal standard and when consequently the wound heals slowly, it is better to wait a longer time.

The results of treatment in the hypertrophic form of rhinitis were, in eighteen cases, excellent, improved in nineteen, partial improvement in seven, not improved in one, and no information obtained in five. In the intumescent form the results were excellent in twenty-seven, improvement in thirteen, partial improvement in three, no improvement in one and not stated in six. It is only fair to state that in most of the cases in which the results are given as not improved or partially improved, the treatment was unfinished. In like manner, with those in whom no statement of condition was found in the records, it is reasonably certain that the majority of them obtained relief.

Adding the results obtained in both series, we have seventy-seven cases in which the results were excellent or much benefited, ten in which partial improvement was found, two in which there was no improvement and eleven cases in which there was no statement as to improvement or lack of improvement, and of these eleven, in eight, the treatment was of less than one month's duration and was unfinished.

It is interesting to note that three cases of asthma were found in this list which were treated locally and with internal remedies. The asthma, although the nasal trouble was relieved, failed to improve in two. In one case, with the im-

provement in the nose, relief was secured from the asthma. Mouth-breathing persisted in two cases, although the nose was freed of obstruction. This was probably due largely to force of habit.

CONCLUSIONS.

1. The galvano-cautery when properly used offers one of the best, if not the best, methods for the treatment of the intumescent and hypertrophic form of rhinitis.

2. The dangers of middle-ear infection have been greatly exaggerated, not any case in the series and only one among several thousand cauterizations, having come under our observation.

3. The liability to adhesion-formation is not great, providing sufficient care is taken not to injure the opposite septal mucous membrane; and providing in cases in which the subsequent swelling is marked, a probe be passed between the opposing surfaces in four or five days.

4. A 4 per cent solution of cocain, according to the formula published, is sufficient in the vast majority of cases to induce complete local anesthesia, three to six applications on a cotton-wound flat applicator being sufficient for the purpose. As a result of experience, especially in cases of marked intumescence, we believe that a spray of adrenalin or suprarenalin gr. $\frac{1}{8}$ to the ounce materially assists in producing anesthesia.

5. The objection that the galvano-cautery destroys too much of the mucous membrane, does not obtain if the cauterization is linear, as here recommended, and if it is done properly, whereby very little mucous membrane is destroyed.

6. Scab and crust formation does not occur any oftener following cauterization than after other nasal operations. In fact, it was noted in but very few instances and in some of these a change in the spray solution caused a cessation of this trouble.

7. No packing is needed to prevent hemorrhage and this factor makes the discomfort following the operation very much less than after some other methods.

8. There is very little pain after galvano-cauterization of the turbinated bodies.

IV.

THE TREATMENT OF ACUTE AND CHRONIC MAXILLARY SINUSITIS.

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The treatment of a maxillary sinusitis will of course depend to a certain extent upon the cause, and for this reason, all pathologic processes about the roots of the teeth must be carefully looked into and when present removed.

Diseased roots, however, are not frequent etiologic factors, as by far the larger number of cases of antral disease are secondary to pathologic conditions in the nose.

Treatment of Acute Maxillary Sinusitis:—In the majority of the cases of acute inflammation of the antral mucous membrane, a policy of conservative non-interference is best. By this I do not wish to be understood that nothing should be done, but that not *too* much should be done at first. We are probably all agreed on this point. Proper treatment of the nasal condition will in the majority of the cases be all that is necessary. When the mucous membrane is much congested, particularly in the middle meatus, the use of equal parts of a weak cocain and adrenalin solution is extremely useful.

I am in the habit of saturating pledgets of cotton with this solution, allowing it to remain in the nose for a time. As there is usually a certain amount of pus in the nostrils, and as acute maxillary sinusitis so commonly complicates influenza, when the nasal mucous membrane is very much congested anyway, the use of sprays, particularly coarse sprays, is not without the danger of carrying infection to the middle ear. A very fine spray of a 1,20,000 or 1-30,000 adrenalin, with a little cocain, may be used after the acute symptoms have partially subsided, but during the acute stage, the cotton pledgets are safer.

I wish to take this opportunity to say a word against the use

of the ordinary douche by patients themselves, in the treatment of acute conditions of the sinuses. In a patient's hands this is sometimes a dangerous thing to use.

The writer has had two severe cases of otitis media resulting from the use of the douche, the patients, in both cases, having received the douche from a general practitioner. During an acute sinusitis, the nasal mucosa is usually very much inflamed, and with the presence of pus, an infection can, as before stated, be readily conveyed to the middle ear by way of the Eustachian tube. If it is necessary to wash out the nose, it should be done by the attending physician and not by the patient.

Inhalations from a steam atomizer or croup kettle, and hot external applications to the antral region, are very useful. I am in the habit of using a mixture of compound tincture of benzoin, oil of turpentine and tincture of hyoscyamus in a steam atomizer or croup kettle, and having it inhaled through the nose. If free drainage, and some relief from pain, should not be obtained by these measures in 48 hours, paracentesis may have to be resorted to, particularly if the tension symptoms are great.

Puncturing the antrum through the inferior meatus where the naso-antral wall is thinnest, usually about an inch back, is a simple procedure, but should be performed with strict aspesis. A sterile, warm, saline solution answers very well for irrigating the antrum. In some acute cases, a single irrigation will suffice, in others, if the discharge from the antrum persists, it may have to be done a number of times. In such cases a temporary opening through the inferior meatus, at the lowest possible point, in order to obtain good drainage, may have to be made. The antrum can then be easily washed out.

We read much about washing out the antrum through the natural opening. Now while this can be done in cases of chronic empyema, I must confess that when the nasal mucosa is much congested, except in unusual cases, I believe it is not at all as easily accomplished in acute cases, as we are often led to believe. An oil spray of menthol and albolene, or menthol, albolene and hydrocarbolene, to which is added a small amount of cocain or adrenalin, is very useful while the nasal mucosa is much congested.

Perhaps something should be said concerning the constitutional treatment of acute maxillary sinusitis. In the beginning

of an attack, calomel, followed by a saline, and drop doses of aconite repeated until the patient perspires freely, are useful in relieving the congestion of the mucous membrane. I do not believe that the coal tar products are of much service in controlling the pain, although occasionally 5 gr. doses of phenacetine or migraine tablets, repeated as often as necessary, will afford some relief. It is always wise to stimulate patients somewhat while giving coal tar products, because symptoms of cardiac depression have been known to develop after comparatively small doses of such drugs, particularly acetanilid. Morphin should not be used, because just as in acute frontal sinusitis or mastoiditis, it masks the symptoms to such an extent at times, that well marked tension symptoms might be overlooked.

In connection with the question of irrigating the maxillary antrum, it is interesting to determine whether it is possible, as stated by Lermoyez (*Annales de Maladies de l'Oreille du Larynx, du Nez, etc.*, Nov., 1902), for the frontal sinus to become infected by carrying some infected material into the sinus during irrigations of the antrum of Highmore, either by the way of hiatus semilunaris, or even more directly, when a direct communication exists between the frontal sinus and antrum. Menzel (*Archiv. für Laryngologie und Rhinologie Bd. XVII, Heft III, 1905*), has shown by his experiments in cadavers, that this is not possible.

His conclusions are briefly as follows: The irrigating fluid injected through an opening into the antrum of Highmore only reached the frontal sinus when an external opening had also been made into the sinus. In all the trials made, in which no external opening had been made into the frontal sinus, there was not a single case in which any of the irrigating fluid, even when forcibly injected into the antrum, reached the frontal sinus.

The sinus being filled with air, will not allow the entrance of any of the irrigating fluid. In cases, on the other hand, in which an external opening had been made into the frontal sinus, the irrigating fluid could be readily forced from the antrum into the sinus.

These investigations of Menzel would seem to be rather conclusive as showing that the frontal sinus can not be readily infected during irrigations of the antrum.

It is of particular importance in the acute cases to correct any nasal condition interfering with proper drainage from the antrum.

To come now to the treatment of chronic maxillary sinusitis, which as a rule is a chronic empyema, I do not think that any methods of treatment except the operative ones need be considered.

Considering first the operation through the naso-antral wall, it may be said that while this method is very successful in selected cases, in the writer's experience at least, it is not always followed by the best results. The writer has operated on a few cases of chronic antral empyema by this method, and in all but one case, the results were not good, the discharge did not entirely cease, and in two cases the radical operation through the canine fossa had to be performed eventually. In each case, a large opening had been made through the internal wall, after resecting a little more than the anterior portion of the inferior turbinate, and the degenerated antral membrane and granulations were removed as thoroughly as possible through the nasal opening. Perhaps the writer's technique was faulty in some way, or perhaps the opening through the naso-antral wall was not large enough. This method has many strong advocates, however, such as G. L. Richards, Freer, Rethi, Curtis, Myles and others. It is perhaps true, as stated by Freer (*The Antrum of Highmore: The Removal of the Greater Part of its Inner Wall Through the Nostril for Empyema. The Laryngoscope*, May, 1905), that many of the operations through the naso-antral wall are not successful, because not enough of the internal wall is removed.

Rethi (*Wiener klinische Wochenschrift*, No. 34, 1904) recommends the removal of the anterior two-thirds of the inferior turbinate, and an extensive resection of the nasal wall of the antrum both in the inferior and middle meatuses.

Claoue (*Semaine Medicale*, Oct. 15, 1902) makes a large window through the inferior meatus.

H. H. Curtis (*The Laryngoscope*, October, 1903) reports an operation in which after the anterior third of the inferior turbinate is resected, an opening is made through the lower part of the inner antral wall with a trephine and enlarged with a burr. Case reports were not given in this paper.

Richards (*Journal of the American Medical Association*, Sept. 16, 1905) reports good results with this method, because he states "that in many cases the antral mucous membrane is not particularly degenerated." A permanent opening is usually established through the naso-antral wall only in the

chronic cases, and in the majority of these the membrane is not only degenerated but greatly thickened.

Coakley's investigations prove this conclusively. (Observations upon the Pathology of Chronic Suppurative Inflammations of the Antrum of Highmore, *Trans. Amer. Laryn. Ass.*, 1902.)

The pathologic changes in the cases examined by him showed great thickening of the mucous membrane in every case. This he found was due to an increase in the loose connective tissue layer beneath the epithelium.

I do not think that the operation through the naso-antral wall will turn out to be permanently successful in every chronic case where this thickening and degeneration of the antral mucous membrane exists.

Richards also states, however, "that if the condition does not improve after a reasonable length of time with this method, any nasal operation alone will not be sufficient, and nothing less than the radical operation through the canine fossa will bring about a cure." The rule in all operative work upon the maxillary sinus, just as in the case of the frontal sinus, should be to perform the operation that will be followed by an obliteration of the sinus. Such an operation, too, should be performed, that every part of the sinus can be directly inspected. This is not easy in operations through the nose. We all know how difficult it is to maintain an opening through the naso-antral wall, even when a large opening is made. Granulations will develop and the opening will become small in a short time. In selected cases, however, this operation is undoubtedly sometimes followed by excellent results, for which we have the testimony of the careful observers mentioned.

Where no ethmoid disease exists, and where the nostril does not contain numerous polypi, this operation may be tried first. When multiple polypi (a common symptom of chronic sinusitis) exist in the nose, in conjunction with a chronic purulent discharge from the antrum, the antral mucous membrane will be found greatly thickened and degenerated in every case, in fact, in many cases the antrum itself will be found with polypi and granulations.

In such cases, where we have almost a positive assurance that the antrum will be found greatly diseased, it seems a better plan to perform the radical operation in the first place, rather than to establish an opening through the naso-antral wall and then later perhaps being compelled to perform the radical operation any way.

Nothing but the radical operation, the Caldwell-Luc, or some modification, and the complete removal of the antral mucous membrane will result in a cure in many such cases.

I will not describe the technic of the radical operation, as it is so familiar to everyone. Just as much of the anterior wall as possible should be removed and all of the mucous membrane.

The writer has found the Luc forceps very useful for rapidly removing polypi and granulations from the antral cavity.

It is almost impossible to remove all of the degenerated membrane by any except the radical operation. The Coakley lamps that are so useful in frontal sinus work, are of the greatest service for inspecting the antrum while operating.

There is no positive assurance, in cases where the operation through the naso-antral wall has been performed, and the opening is finally allowed to close, that the sinus may not again become infected, particularly during influenza epidemics.

In conclusion the writer would briefly report the two following, rather unusual, cases of chronic antral disease.

Mr. J. L., merchant, aged 45 years, has been under the writer's care for several years for recurring nasal polypi. During the past four years, polypi have been frequently removed from the left nostril. Antral disease was discovered when he first came under observation, but he was always satisfied with the relief obtained after the removal of the polypi, and persistently refused any other operative work. During the past year the discharge of pus was so profuse, the polypi recurring about every two months, and he suffered so much from pain in the left half of the head and in the eye that he consented to the radical operation. This was performed in the usual way and the left antrum, which was very large, was found filled with pus and a mass of apparent polypi and soft granulations. There was very free bleeding when these were cleared out with Luc's forceps. The mucous membrane, which was greatly degenerated and thickened, was removed with curettes. It is now a number of months since the operation has been performed and there is no discharge from the nose, the left nostril being entirely clean. The histologic examination of the mass removed from the antrum is interesting. It is as follows:

Bender Hygienic Laboratory, Albany, N. Y.

The specimen removed from the antrum shows a very rap-

idly growing papillary polypi, with infection, degeneration and necrosis. There is no definite evidence of malignancy, but from the general appearance of the tumor, I would advise careful watch for recurrence.

Very truly yours,

R. M. Pearce, Director.

This examination explains the rapid recurrence in the nostril after each removal of the growths. The histologic examination is also of interest, because it shows perhaps the first stage in the change of a benign to a malignant growth. The earlier examinations of the growths removed from the nose, in this case, showed they were the ordinary polypi. The last examination of the growths removed from the nose also showed, however, a beginning change in the histologic structure.

The second case is that of a young woman, aged 36 years. She has had a purulent discharge from the right nostril for years. Transillumination showed a shadow under the right eye, and a dark pupil. On examination numerous polypi were found in the middle meatus of the right nostril. The anterior ends of both inferior and middle turbinates were much enlarged and edematous.

She would not consent to the radical operation, so after removing the polypi, the anterior end of the middle turbinate, and a little more than the anterior third of the inferior turbinate, an opening was made through the inferior meatus. The antrum was filled with soft granulations and there was a free discharge of pus. The patient's general condition was so poor that the pus from the antrum was subjected to a microscopic examination. It was found to contain tubercle bacilli. None were found in the sputum, however, nor could any general tuberculosis be discovered. Coakley, in the paper before mentioned, reports the case of a young man, aged 26 years, with double antral disease. Microscopic examination of the scrapings from the left antrum showed the presence of giant cells and a few tubercle bacilli. Sputum examinations in this case were also negative.

Before closing this paper the writer would like to say a word about the use of "somnoform" in operations upon the upper air passages.

It is an admirable and safe anesthetic, and can be used to great advantage as a preliminary step in the administration of ether. It is used in a special somnoform inhaler. It is composed of chlorid of ethyl 60 per cent, chlorid of methyl

35 per cent and bromid of ethyl 5 per cent. The patient is completely under the influence of somnoform in thirty or forty seconds, and then the administration of ether can be started at once. It does not produce cyanosis as is the case with ordinary nitrous oxid gas. It certainly shortens the administration of a general anesthetic very much.

V.

THE USE OF THE BURR IN THE MASTOID
OPERATION.

BY A. BARKAN, M. D.,

SAN FRANCISCO, CAL.

There exist probably no more honest seekers for truth than medical men. The taking care of health, the saving of life, is the goal we endeavor to reach. The task is so noble, the road often so dark! If then, an impediment, no matter how slight, exists, whose removal might tend to make our work easier and above all, safer, the duty in the matter is clear. The more so, if the surgical path before us is narrow and tortuous, and beset with difficulties on all sides. Having enjoyed exceptional opportunities, during two periods of work at Prof. Schwartz's clinic, for the study of mastoid operations, then as now exclusively performed with chisel and mallet, I used these instruments with fair satisfaction for a number of years. Then I witnessed for the first time Prof. Macewen do a radical operation with the burr of a Philadelphia make, driven by a simple but effective surgical hand engine. I was so impressed with the greater ease, the infinitely greater safety, the artistic feature of handling the simple instrument, that from that date, about ten years ago, to this, with the exception of a very few operations done in the country or in the hospital when power unexpectedly gave out—a very unusual occurrence indeed,—I have used no other instrument than the burr. A series of over 100 cases done in this way allows me to pass an opinion as to the efficiency of this method and to speak from the standpoint of the aural surgeon, practically and briefly.

For several years I used the same dental surgical engine driven by a nurse's foot, with which Macewen did, as far as I know, all of his path-finding work in aural and brain surgery. Then, at his direct suggestion, White & Co., of Philadelphia, constructed a surgical engine, driven by the direct current, which I have used with the greatest satisfaction. The cut through skin and periosteum is made as usual. Macewen's triangle is well exposed; then the

largest of the three globe-shaped burrs is applied to the surface of the bone in the triangle, the handle of the instrument is held like a pen, and moderate pressure is applied on the bone. If the driving cords of the instrument are properly adjusted, and the current supply of the right intensity, the revolutions of the burr produce, within a few minutes, a channel which, lying parallel to the posterior wall and a little above and behind the meatus, tends toward the antrum. An accumulation of bone sand between the furrows of the burr is practically prevented by an attendant dropping a sterilized normal saline solution upon the burr. According to the operator's individual inclination and the density of the bone, the rate varies at which the burr is allowed to penetrate into the depth. Considering that the surface of the bone attacked by the burr is rendered smooth at once and needs no **beveling** off with the chisel, the rate of progress is about as good as that in chisel work. The large sized burr is used until the antrum is reached. As the canal progresses in depth, the outer edges of the wound are beveled down and the opening enlarged. The burr need not be changed at all, or if changed for one of equal or smaller size, the mechanism of the handle is so perfect that the change is accomplished in a few seconds' time by the nurse who attends to the instrument, while the surgeon explores with a Macewen searcher one or the other of the peripheral cells of the mastoid, granulation tissue, or perhaps the bone which overlies the sinus, if the latter be projecting forward, as it has done in a great many cases of my series. In this very instance the beauty of working with the burr is at once telling, for as the bluish color indicating the nearness of the sinus becomes apparent, the burr in the surgeon's hand continues to remove layer after layer of bone until the sinus is safely exposed. This shaving off of the bone, overlying the sinus, is so easily and safely accomplished that in the hands of the beginner in mastoid work, who is liable to propel his chisel with smart strokes, the burr is the infinitely safer instrument, and will, I am persuaded, often prevent accidental opening of the sinus.

The antrum being found and cleaned, the removal of the posterior osseous wall is just as readily accomplished by the burr. At first the large sized burr is used and as the medial end of the posterior wall is reached, it is changed for one of medium size. I have found a strabismus hook useful in ascer-

taining how much of the spur is still left standing. A competent assistant keeps the same in position, hugging the spur with it, as it were, until the burr comes in contact with it. In that way, the spur is entirely removed and lesion of the facial canal is avoided. The removal of the bone overlying the aditus, the smoothing off of the facial ridge, or the removal of diseased bone in all parts of the operative field is accomplished with the burr.

The smaller ones are used in the depths. An electric forehead lamp is brought into use if necessary. Of late years I have not used any protector whatever, neither Stacke's nor the strabismus hook, but proceed slowly and cautiously in the depth. If further work is to be done to the tegmen of the antrum or tympanum, still the burr may be used to great advantage.

If it be necessary to expose the middle fossa, that can be done certainly with as much ease and safety with the burr as when the burr is used to expose the lateral sinus. A direct lesion of the facial nerve attributable to the burr is only possible when caries has extended into the Fallopian canal. That has happened in a very few cases, and can not be laid to the account of the burr.

That the shock of the operation, in all cases, but especially where there are cerebral complications threatening or already present, is infinitely smaller than when chisel and mallet are used, is a proposition so clear, so humane, I should say, that I fail to understand the almost exclusive use which is still made of the chisel. Conceded that in the hands of lightning operators, the radical operation may be possibly accomplished with advantage of about 10 or 15 minutes' time, I feel sure that this is accomplished at the expense of safety; the burr then recommends itself for use because it is by far the safest of the two instruments; lesions of the lateral sinus and of the dura in the middle fossa may be avoided with certainty; it produces the slightest amount of mechanical shock in and around the temporal bone; it bevels off the edges of the cavity to a nicety, and prevents entirely spiculae of bone becoming loosened, causing mischief.

I venture to assure my colleagues that having once witnessed mastoid work done with a surgical engine of modern make, whether driven by electricity or by hand or foot, they would not be willing to submit their own heads for work of this kind to the mallet and chisel.

While the surgical engine is perhaps a trifle too large to be carried about to the patient's house, the simple surgical engine, driven by hand or foot, might do very well in such a case. The installation of the perfected electrical instrument, however, is, to my mind, a necessity in every ear hospital.

In conclusion I wish to remind my colleagues of the words of the master. They are put down on pages 299 and 303 of Macewen's work, "Pyogenic Infective Diseases of the Brain and Spinal Cord." As this work, so inexhaustible in what it teaches, as far I know, has not had a second edition since its first appearance in 1893, whereas a flood of aural text books have made their appearance, I will be forgiven for referring again to it. A master of the chisel in other fields of surgery, Macewen advises most emphatically against its use in mastoid work. Can we afford to neglect such advice? Must we not give it a fair, unprejudiced trial, using the best instruments at our hand for that purpose? He neglects a sacred duty who fails to do so.

The following is Macewen's expression on the subject:

"Most surgeons use the chisel, driven by a mallet, for opening the mastoid antrum. No doubt it is often successfully exposed in this way, and in lack of a better instrument, the chisel may be used. Its use, however, for opening the mastoid antrum is objectionable: first, because in operating upon a restricted area, surrounded by and full of apertures, some containing delicate structures, the wounding of which may occasion serious and even fatal results, the antrum being situated at a variable depth from the surface, the intervening osseous tissue being of various consistency, it is a source of danger to use a chisel driven by a mallet, which may be suddenly impelled into the interior of one of those spaces or into the cerebellum, brain or sigmoid.

"Such accidents have occurred during attempts to open the mastoid antrum. The sigmoid sinus has frequently been accidentally opened by the chisel, several of the cases surviving, though a number have died. In four unpublished cases which have been communicated to the author, four surgeons, in their several endeavors to open the mastoid antrum, have accidentally driven the chisel into the sigmoid sinus. In each of these there was profuse hemorrhage, causing abandonment of the operation; the parts being plugged to arrest bleeding. Three of these four patients ultimately died. In

two, the surgeons believed that death was not hastened by the accident, but from meningeal complications which previously existed. It is probable that a fatal issue would have occurred in any case. In one, the amount of hemorrhage within a few seconds was very great. The patient died in forty-eight hours from extensive cerebro-spinal meningitis. A hemorrhage of considerable size was found in the subdural space in the same cerebellar fossa. The fourth case recovered.

"On one occasion, a young surgeon, in endeavoring to open the antrum with a chisel, found, on giving it an impact with the hammer, that the instrument suddenly entered a large cavity, from which pus issued. At post mortem examination it was seen that the chisel had penetrated the sigmoid groove, pushed aside the sinus, which was fortunately thrombosed, and entered the cerebellum, from which, on withdrawal of the instrument, pus flowed.

"Secondly, the repeated blows with the hammer impart considerable vibration to the mastoid and adjoining structures, and when the tegmen tympani or the sigmoid groove is thinned, the concussion may cause these thinned and pliable structures to give way, or cause a rupture of the granulations covering them, and thus permit inoculation of the fresh wounds, in the membranes, or in the brain itself. Pus within the brain or cerebellum, received through concussion of violent vibrations or shocks, could easily be scattered, or a large abscess near the ventricles or meninges might, by the violent impacts conveyed to it, burst into the ventricles or meninges, thus producing serious if not fatal results. On one occasion (in a case reported to the author by the surgeon in charge), while the chisel and mallet were being vigorously applied to open a mastoid antrum, the patient's breathing was suddenly arrested; the relations of a large cerebellar abscess which was present being probably disturbed by the communicated vibrations, as there was no laryngeal obstruction.

"Thirdly, the aperture left by the chisel is rough and ragged compared with the polished surface and beveled edges obtained with burr, which greatly facilitates the after-dressing and treatment."

920 Market Street.

VI.

NON-DIPHTHERITIC MEMBRANOUS PHARYNGITIS AND RHINITIS WITH HYPERPYREXIA AND AN UNUSUAL NUMBER OF COMPLI- CATIONS—REPORT OF CASE.*

BY JAMES F. McCaw, M. D.,

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RHINOLOGICAL AND OTOLOGICAL SOCIETY, ETC.

The case which affords the basis for this paper, I saw
in consultation with Dr. J. D. Spencer and Dr. C. N. Bibbins,
March 15, 1904, when the following history was obtained.

Patient, female, aged 28 years. Mother died of pulmonary
tuberculosis. While in New York City, about four and a half
years ago, she developed an acute purulent otitis media, fol-
lowed by mastoiditis on the left side, and was operated upon for
the same by a very eminent general surgeon, after consultation
with a prominent member of this society. From this she made
an uneventful recovery, and had been perfectly well until six
weeks before, when she suffered from an attack of influ-
enza.

Although up and around, she was still weak and exhausted,
not having fully recovered from her influenza attack, when
her present illness began one week ago with a severe sore
throat, a profuse watery nasal discharge, followed by a chill,
high rise of temperature, rapid pulse and marked prostra-
tion. About twelve hours later, a pseudo-membrane began
to develop, first on the tonsils, rapidly spreading to the soft
palate and tongue, extending thence to the pharynx, post-

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gological, Rhinological and Otological Society at Syracuse, N. Y.,
February 10th, 1906.

nasal space and nares. The nostrils were so completely occluded that it was impossible to force air through them thirty-six hours from the beginning of her illness. Twelve hours later redness, swelling, edema and pain had developed over the superior maxillary and infraorbital region of both sides, more pronounced, however, over the right. Pain in the left ear, with subsequent purulent discharge and the same condition in the right, followed in quick succession.

I first saw the case at this stage of development and upon examination found the following conditions: Patient profoundly prostrated, mental hebetude, temperature 104.5° F., pulse 126, and swallowing difficult. There were noticeable chemosis and proptosis of the right eye, redness and swelling over the antral and infraorbital region on each side, with pain and tenderness on pressure over the same areas. Nasal obstruction was complete. Each nostril was found occluded with a thick grayish-white membrane which completely filled the cavities. This membrane covered the post-nasal space, extended down the posterior and lateral pharyngeal walls to the tonsils and soft palate and involved the lateral walls of the buccal cavity and tongue as far forward as the tip. This pseudo-membrane was deposited on the tonsils, soft palate, tongue and buccal cavity in the form of large islands, between which was red and highly inflamed mucous membrane; while in the nasal chambers, post-nasal space and pharynx its continuity seemed to be unbroken. Any attempt at removal of this deposit left a raw and bleeding surface.

The membrana tympani in each ear was very highly inflamed, edematous and bulging, with a small perforation in the lower posterior quadrant of each, from which bead-like drops of pulsating pus were oozing. No swelling or redness over the mastoids, but slight tenderness on deep pressure over the left. Each membrana tympani was freely incised, and an examination of the pus from these and swabbings from the throat and nostrils showed staphylococci present in great numbers with a few streptococci. Klebs-Loeffer bacillus was absent.

As a result of this finding, I attempted to clear the nostrils of the deposit as thoroughly as possible without treating the mucous membrane too harshly, and instituted regular syringing of the same with bichloride solution 1-10,000, followed by a mild alkaline solution every three hours. The other areas of

infection were treated in a similar manner. This, together with supporting treatment, constituted my method of attack.

For the next four days, the general condition of the patient seemed to remain about the same, temperature ranged between 104° and 105.5° F., pulse 120 to 140; mental hebetude alternating with mild delirium supervened. About this time there was noticed less activity in the reformation of the false membrane, it was less tenaceous, coming away more easily and not leaving that extremely red and bleeding surface, as had previously occurred. The swelling and redness over the infra-orbital and antral regions slowly subsided and tenderness disappeared. The false membrane had entirely disappeared in ten days and her general condition improved, but there had in the meantime appeared some swelling, redness and increased tenderness over the left mastoid region. About this time pronounced gastro-intestinal symptoms supervened, followed by tympanites, but only slight diarrhea and tenderness. To this was added a most annoying cystitis with constant and severe pain. With these developments her temperature again became high with frequent chilly sensations. A Widal test gave a negative result.

In view of her general condition, which was very bad at this time, I did not feel warranted in subjecting her to the shock of opening the mastoid, but was contented with keeping the middle ear thoroughly drained, meeting the other indications, and getting the patient in a condition where I felt her life would not be jeopardized by a mastoid operation. About one week from this time, I opened the mastoid, cutting down through the cicatricial tissue of the old wound opening into an abscess cavity. Although some difficulty was experienced in locating the antrum on account of distorted landmarks, this was finally accomplished. The zygomatic cells, those in the upper posterior portion, and the tip cells which had been left at the time of her previous operation were found involved and necrotic. All diseased tissue was thoroughly curetted away and the mastoid wound dressed in the usual manner.

From this the patient rallied nicely and was convalescing satisfactorily when two weeks later she began to complain of a fullness and pain in the left side of throat, temperature 101°, pulse accelerated. Upon examination there could be seen on the left side of the posterior wall of pharynx, on a

line with the soft palate and extending upward, a deep purplish red, slightly tumefied area. Pronounced bulging of this area, crowding the soft palate forward, tenderness to pressure and an indurated feeling at a corresponding point on the neck, dysphagia and increased constitutional symptoms supervened in thirty-six hours; at which time a large retro-pharyngeal collection of pus was evacuated with immediate relief. From this time on the patient made a rather slow but uneventful recovery.

In medical literature there is a lack of unanimity among authors regarding the nature and classification of these cases. They are described as diphtheritic, diphtheroid, fibrinous and membranous pharyngitis and rhinitis, phlegmonous pharyngitis, streptococcus infection, staphylococcus infection, etc., all of which is very confusing.

The question, then, of etiology and diagnosis becomes one of interest and importance. In my own case I must confess that at first I accepted the report of the bacteriologist with some skepticism, as the clinical evidence seemed to warrant a diagnosis of diphtheritic infection. However, after a more careful study of the case, we find abundant evidence to account for the unusual symptoms and phenomena present. Most authors tell us that non-diphtheritic, membranous or fibrinous rhinitis or pharyngitis is a mild disease with only slight constitutional symptoms, usually occurring in children, the temperature rarely going above 101° in the severer cases, and in some the symptoms are insignificant after the second day. While this may be so in the majority of cases, it was clearly the exception here. The wide distribution of the false membrane, with evident involvement of the nasal accessory sinuses, the hyperpyrexia and extreme prostration, evidence of a profound and virulent infection, at first seem incompatible with the bacteriological finding, but when it is considered that this patient was convalescing from an attack of influenza, her physical condition and resisting power of the tissues necessarily low, it is easy to account for the unusual activity and virulence of the invading organism, and the number of subsequent complications.

The mastoid complication was of added interest as further evidence in substantiating the views of those who strongly advocate the entire removal of all mastoid cells, including the zygomatic group and tip whenever the process is attacked

surgically. Where this is not done and a second operation becomes necessary at any time, it is made more difficult from the destruction of the surgical landmarks.

In considering the complicating retro-pharyngeal abscess, the possibility of an extension or burrowing of pus from the mastoid wound might be thought of, but the wound was perfectly clean, and although searched for, no opening of communication could be detected. Another point against this view is the fact that the first evidence of its appearance was in the posterior pharyngeal wall and later was felt in the neck. From this we conclude it was another complication of the primary infection.

The last, but by no means the least in interest, is the pathology of these cases. The fact has been clearly demonstrated by experimentation that general systematic infection may take place by dissemination of the poison from the upper air passages; in some cases passing through the lymphatics with great enlargement of the cervical lymph glands; in others directly into the blood current by way of the small capillaries and so reaching the general circulation. These facts have been proven beyond question and I think they are now accepted by most observers.

The question naturally suggests itself, why is it, that in some cases the clinical evidence of general infection are so much more profound, and the local manifestation so different from others, in which the infecting agent is apparently the same? Poynton, before the British Medical Association, sums up the situation very clearly when he says: "That border line between pathogenic and non-pathogenic is, in my opinion, the weak side of bacteriology at the present time. Because of the obscurity of this most pressing question, I have always fought hard against any assumption that whether a sore throat is septic, or rheumatic, or catarrhal, is simply a question of the resistance of the patient. In opposition, I maintain that we do not know when we look at such a throat whether the fate of the patient turns upon his resisting powers or upon some special properties in the infective agent. Certainly I think we shall admit, so far as diphtheria is concerned, much rests with the micro-organisms, and though in those other infections so vaguely termed septic, we are at present in confusion, I hold firmly to the view that when you have great clinical differences, then you have some special factor in the

infective agent. I admit the factor of personal resistance, but not as the explanation of the great differences that there are between the illnesses that follow rheumatic, septic and catarrhal sore throats. In the search for these differences, difficult and slow though it may be, lies the hope of the discovery of the special poisons and their antidotes." He also alludes to the fact that probably infection from the throat may occur without any appreciable local symptoms, that the local inflammation is only a measure of the local disease, and not of the tendency to general infection.

VII.

REPORT OF A CASE OF DEFORMITY OF THE AURICLE FROM PERICHRONDITIS FOLLOWING RADICAL OPERATION FOR CHRONIC MIDDLE EAR SUPPURATION AND MULTIPLE FURUNCLES.

BY WILLIAM H. HASKIN, M. D.,

NEW YORK.

The patient, Mrs. M. W., age 36 years, was referred to me by Dr. T. J. Harris on June 6, 1905. His records report that she complained of headaches, dropping in the posterior nares and oppressive breathing.

On April 17th a spur was removed from the right side of the septum, and treatment was given twice weekly for hypertrophic conditions throughout.

June 7th still complained of headaches, though breathing was easier and post-nasal dropping less. As the pains were always referred to the left side of the head, she was sent to me for an ear examination.

Her history to me was that she had had a severe attack of diphtheria seven years ago, followed by an abscess in the left ear which ran steadily for five months. She also said that all her troubles dated from that time. She complained of marked deafness in left ear, of severe ear-aches at intervals and of hearing her own voice repeat itself, in the left ear.

Hearing tests showed: Watch on contact only; Acoumeter, 8 inches; Weber, + left; Rinne B C better than A C for C₂ fork.

The canal appeared normal. The membrana tympani presented marked retraction of lower and anterior portions, with extensive calcareous deposits and a large perforation into the attic which appeared full of cholesteatoma, but dry. The Eustachian tube was freely open and dry. There were no evidences of acute inflammatory action present, and no treatment was advised as long as existing conditions remained.

June 19th she returned with an extensive furuncle at the meatus which was evacuated, and on its subsidence the attic was found to be discharging.

June 25th another furuncle appeared, and this was accompanied by a greenish, very offensive pus, in which were found the bacillus pyocyaneus from the middle ear. From that date the patient got no relief from pain, and the superior and posterior walls apparently became involved throughout. A deep incision from the attic outward was made under gas, but did not improve the condition. The patient was using hot bichlorid douches and external hot poultices.

On July 12, 1905, she was admitted, on the advice of Dr. Harris, and operated upon, on the following day, under gas and ether anesthesia. The usual radical operation was performed, there being present throughout a condensing osteitis. The antrum and attic were found filled with cholesteatoma and granulations, which were thoroughly removed. The facial canal was exposed in its descending portion, but the nerve was not severed. The canal was split and then packed with iodoform gauze. The posterior wound was sutured with silk, and sterile dressings were used.

Subsequent history: Written by Dr. Foster, the house surgeon.

July 15. Outer dressing changed. Wound clean and dry.

July 19. First dressing. Wound clean and looking well. Stitches removed from posterior wound. Healing here perfect.

July 22. Wound inside looking well. Considerable soreness and redness about canal entrance, especially above where flap was cut.

July 23-25. Wound granulating nicely, but inflammation about canal grows worse. Apparently a chondritis or perichondritis has set in. Taken home.

From this time until August 4th patient was dressed in clinic. Swelling about canal increased and spread to whole of cartilaginous auricle. Patient suffered intensely and was re-admitted to hospital August 4, 1905.

August 5. Intense inflammation of auricle and much pain. Dressed with Burrow's solution.

August 7. Swelling of auricle continues to increase; feeling of fluctuation in it. Burrow's solution continued.

August 10. Auricle paler, but more fluctuating; pain still severe.

August 11. Auricle incised under gas anesthesia. Opening made behind. Considerable pus evacuated. Packed with iodoform gauze. Middle ear looking well.

August 13. Packing changed. Considerable pus evacuated. Still much deformity of auricle and a great deal of pain. Patient requires some narcotic almost every night.

This condition continued with little change for the next two weeks. It was apparent that the cartilage was coming away little by little.

After September 1st the discharge became more scanty and the auricle began to contract. When she was discharged September 12th the auricle was almost devoid of cartilage and the posterior wound in it clean. However, there had set up some swelling about the tragus, with some tenderness.

September 13. Small fistula in posterior surface of auricle. Hard mass just under skin in front of tragus has been gradually swelling and apparently fluctuating. Advised opening, but patient refused, so hot poultices were applied. Middle ear perfectly dry. No improvement in hearing.

Present condition:

Auricle badly deformed from destruction of cartilage. Canal and middle ear dry and completely healed. No pain. Hearing the same as before operation. No ill effect from opening the facial canal.

The literature of perichondritis is comparatively scarce. Politzer after describing it makes the remark that since the advent of the radical operation this condition is not so rare.

Dr. E. Gruening, in the *Archives of Otology*, 1890, said that he had seen but two cases.

Dr. Ferer, in the same number of the *Archives*, said that cases were very rare, only three observers, Chimani, H. Knapp and O. D. Pomeroy having reported any.

Dr. Kipp says it might be caused by too deep incisions into the cartilage in cases of furunculosis.

Dr. H. Knapp, in the *Archives* of 1890, 1898, 1902, reports cases, but always idiopathic.

So far as I have been able to observe from published reports, there are none following the operation for the radical cure, but I feel this must be due to poor indexing, for the Index Medicus, the Surgeon General's Report of the Medical Library and others were searched with the aid of the librarian.

I believe that this case was due to the previous condition of furunculosis, and not to infection from the radical operation, properly speaking, for the wound healed by first intention, and the bony cavity healed without interruption, as can be seen.

VIII.

ACTINOMYCOSIS OF THE MIDDLE EAR, WITH POST-MORTEM FINDINGS.

BY JOSEPH C. BECK, M. D.,

CHICAGO, ILL.

Inasmuch as cases of actinomycosis of the middle ear belong to the very rarely observed affections, especially so when this is the cause of death, I believe a thorough description and report of the same will be of more than ordinary interest. This case has already been reported from the clinical standpoint by Zaufal, of Prague, and by myself, with some reference to the post-mortem findings, and a short abstract of the same which follows:

Carl J., 54 years old, farmer, always healthy, never any ear, nose or throat trouble, had had for about six months swelling back of the ear and the side of the neck on the left side. This swelling was at first hard, soon softened and was never painful. Later on, a third swelling appeared, also on the left side of the neck, which opened and discharged pus through a small fistula. When the first swelling appeared he noticed that his hearing became affected, but no subjective symptoms appeared.

Status. A well developed man, showing no pathological changes in his heart, lungs, abdominal viscera, cerebro-spinal and genito-urinary organs.

The nose. Hypertrophic rhinitis, septum deviated to the left.

Post-nasal space. Examination is negative.

The mouth. The majority of his teeth are absent, and the alveoli are smooth. Some of the teeth are carious, but no periostitis or fistulae can be found anywhere.

The tonsils. Small, pale and with no ulceration. They are not painful on pressure, and no pus exudes on compression. The contents of two large lacunae removed and examined microscopically show various kinds of cocci, and bacilli and stain by the Gram method, showing fragments of threads, which resemble the arrangement of actinomyces.

Oropharynx. Negative.

The ears. Functional test:

R.

vox, 6 meters,

v. s., 1 meter.

L.

vox 0.5 meters,

v. s.

The Rinné test is positive on the right and negative on the left, and the Weber test lateralizes to the left.

The external canal of the left ear shows no secretion. The upper posterior wall is sagged down so that the external auditory canal presents the slit-shaped appearance, and only a very narrow part of the tympanic membrane can be seen, and that appears grayish in color. The right ear appears normal, except that the membrana tympani is slightly thickened. The pinna on the left side is pushed very markedly forward from the side of the head, and the anterior surface of the mastoid appears edematous, but not painful on pressure or percussion. A swelling about the size of the palm of the hand is situated over the region of the mastoid and reaches downward and backward, but not distinctly fluctuating; it has a very deep red color. Another swelling is situated more anteriorly, passing downward and into the depth of the tissues. It has similar characteristics on palpation and inspection, and has a fistulous opening in the region of the tip of the mastoid. When these swellings are compressed, one can obtain a greenish pus containing small granules. During the patient's stay at the hospital another swelling appeared near the angle of the jaw on the left side, at first very hard, then softening down and soon becoming fluctuating, but it did not communicate with the fistula. By probing the fistula, no loose necrotic bone or any rough surface of bone is to be detected.

An operation was decided upon, diagnosis having been made of a chronic suppurative middle ear disease, with mastoid involvement and secondary abscesses in this region, without rupture of the tympanic membrane; the possibility of an actinomycotic process was considered.

Operation. The usual method of operating was pursued as far as the antrum mastoidei, cleaning out all the mastoid cells which were filled with granulations. The characteristic greenish granules of actinomycosis were not found until the depth of the antrum mastoidei was reached. All the abscesses about the region were thoroughly opened up, curetted and drained. All of these cavities contained the greenish pus and granules.

Inasmuch as the microscopic diagnosis of these greenish bodies had not been made, it was decided not to do a radical operation, leaving the ossicles and terminating the operation at this point. Portions of the sternocleido muscle, granulation tissue, greenish bodies and pus were sent to the pathologic institute of Prof. Chiari for examination, and the latter declared that no actinomycosis was present. (I learned from Prof. Chiari that the specimens were sent up after they were too dry and unfit to make a thorough examination and to recognize anything.)

The patient did not show the usual improvement that follows these simple operations; on the contrary, new areas of infiltration developed, these at first very hard, later softened, and discharging large amount of pus and a number of greenish bodies, which Zaufal examined personally, and found to contain the characteristic actinomycosis.

The patient now had considerable pain, and one could see the marked progress of the affection; consequently, another diagnosis was made, namely, actinomycotic process of the temporal bone. It was now one month from the time of the first operation, and the second operation was performed, which was very radical in removing every vestige of diseased bone; thoroughly cleaning out all the pus cavities about the neck and thorough drainage established. Patient lived one week, and just previous to death a third surgical cleaning was necessary in order to relieve him of the tremendous pain that was present, due to the marked distention of the pus cavity. The patient's death was sudden, due to an intracranial hemorrhage which proved to be the ulceration of a huge blood vessel in the vicinity of this destructive process.

Post-Mortem Examination. Conducted by Prof. H. Chiari. The body is well developed, muscular with very little superficial fat; it is pale, with usual post-mortem spots on back. Post-mortem contractures are well pronounced; pupils contracted symmetrically. In the region back of the left ear and lower jaw a T-shaped incision is observed, and from this a number of small incisions lead forward to the side of the neck and backward to the back of the head. Some are united, but most of them are open and granulating, discharging quantities of pus. The soft parietes are pale.

The skull. Measures 57 cm. in the horizontal plane. It is of the usual thickness, and its inner surface corresponds to

the usual appearance of the skull. The dura is tense. Sinus falciformis contains a small quantity of liquid blood and fibrin.

The brain. In the subarachnoid space and the undersurface of the cerebellum, medulla oblongata and pons varolii, the base shows especially fresh extravasated blood, but partially coagulated, and a small quantity of this blood was also found in the subdural space at the base of the skull. The basillar arteries are normal. The left vertebral artery at the lowest intracranial portion is very much thickened, partially thrombosed, and soft to the touch. The pachymeninges and the underlying connective tissue in the region of the left arteria vertebralis are infiltrated with pus which contains greenish granules of actinomycosis. The internal meninges are greatly thickened, edematous, extremely congested and can be peeled off readily. The convolutions are of the usual form. The lateral ventricles are dilated, and filled with a reddish serum. The third and fourth ventricles contain a little clotted blood. The brain structure itself is a little harder than normal, and contains a fair amount of blood.

The diaphragm reaches on the right side up to the third rib, and on the left to the fourth.

The air passages. The mucous membrane of the mouth, pharynx and larynx is pale; trachea contains a small amount of mucus.

The teeth are very defective. Central and lateral incisors, the right canine, the second molar (right), and the root of the left canine in the upper jaw are present. The four incisors and the right molar are in good condition. The gingival margin shows no sign of an ulcerative process.

The tongue is negative.

The tonsils are pale, somewhat larger than normal, the right one on cross-section appearing about normal; the left, however, shows a number of dilated crypts, and nodules of yellowish appearance. From the outer margin of the left tonsil and running outward are a number of fistulous tracts, which are markedly infiltrated. These tracts terminate in a large abscess containing actinomycotic granules. Pharyngeal tonsil and ostium tubae are of normal appearance.

A more thorough examination of the field of operation shows that in the deep muscular layers of the left side of the back and neck, also higher in the region of the cervical vertebrae, a number of pus-infiltrated areas of a radiating character

exist, and the pus contains many clearly distinguishable greenish bodies of the size of a hemp seed.

The joint surfaces between the epistropheus and atlas, also both atlanto-occipital joints are filled with pus; the articulating cartilage on the left side of the latter joint is absent. The bones are all infiltrated with pus, especially so is the body of the sphenoid, as far as the dorsum of the sella turcica. From the left joint surface of the atlanto-occipital, the pus infiltrations can be very clearly traced to the left side of the squama occipitalae, and the posterior surface of the mastoid process, including the incisurae mastoidei. All these surfaces show plainly that they are bare of periosteum; they are very rough. The foramen mastoidei is laid bare by the operation and locked up with a hard, reddish-brown thrombus. The lateral wall of the processus mastoidei, including the bony posterior superior portion of the external auditory canal, was also removed at the time of the operation. This large defect is covered with unhealthy granulations. The antrum mastoidei and cavum tympani are broadly laid bare, and are filled with a similar kind of granulations. The left Eustachian tube is patent, and its mucous membrane is smooth and pale. The malleus and incus are absent. There is no suppurative process in the bony wall of the cavum tympani. A fistulous tract can be traced with a fine probe from the cavum tympani towards the exposed incisura mastoidei, which was not opened up during the operation. The left sigmoid sinus is filled out with a fine thrombus of a light yellow color, which is firmly adherent. The cervical glands on the left side are somewhat enlarged, and on cross-section show whitish discolorations.

The large cervical vessels on both sides are normal.

The heart, lungs and all abdominal viscera are normal.

Microscopic examination. Dr. Herrick, of Chicago, made serial sections of the left tonsil, and found no actinomycosis therein. The plugs found in the tonsil showed them to be composed of debris, epithelium, leucocytes, but no actinomycetes. The lymph follicles showed no pathologic change. The peritonsillar and muscular tissues were infiltrated with pus and showed a few supposedly actinomycetes.

The pathologico-anatomic diagnosis is, therefore, as follows:

1. Actinomycosis partis mastoidei ossis temporis sinistri.
2. Actinomycosis ossis sphenobasillaris, et atlantis et epistrophii textus cellulosi et musculorum coli.

3. Haemorrhagia intermeningealis et ruptura arteriae vertebralis sinistrae, suppurazione actinomycotica affectae.

4. Vulnus trepanatione processu mastoidei sinistri.

Portions of the temporal and occipital bones were excised and I examined them microscopically, as well as part of the ruptured artery in order to determine whether the affection of the artery was due to the actinomycotic process, or whether other microorganisms took part in this most destructive process. Decalcifying the bone, especially the articulating surfaces of the vertebrae, which showed such marked macroscopic changes, I obtained these splendid sections. Using the Gram-Weigert method of straining, also Mallory, we showed distinctly an osteomyelitis with areas characteristic of actinomycosis, and, with an immersion lense can be demonstrated the characteristic ray fungus, with its clubs and threads. The bone itself does not seem to have suffered a great deal of destruction, and shows that the process here is of but recent origin. Other bacteria were not found. The artery shows true actinomycosis within its walls.

EPICRISIS.

The epicrisis of this subject is as follows:

1. Actinomycosis of the middle ear.
2. Propagation of the same to the neighboring structures; that is, soft parts as well as bone at the base of the skull, including the basillar artery.
3. An arteritis actinomycotica, with its final rupture and fatal hemorrhage.

The question one is to ask in this case is how may the middle ear have become infected? Perhaps from the peritonsillar structures, which showed such distinctly actinomycotic changes post-mortem. The other routes whereby the middle ear may have become infected are through the Eustachian tube, through the external auditory meatus, by means of an embolus lodging within the ear, by some of the terminal arteries of the ear, or by the process extending from the lower jaw, a most frequent place for actinomycotic affections.

The literature on this subject is very scarce, and with the exception of this case I have only been able to find one other case of actinomycosis of the middle ear, and that is the case of Majocchi, of Italy, in the *Refera Media*, 1892, p. 120.

Through the kindness of Professor Ferraninii, of Italy, I was able to obtain the original article of Majocchi, and he states that in his case the actinomycosis was first in the lung, and that during a coughing spell he believes a part of the expectoration infected with actinomycosis was thrown into the Eustachian tube, and by that route infected the middle ear.

Ponfick speaks of a case of affection of the ear by means of the actinomyces, but secondary to an infection of the lower jaw. In his case the external ear was principally involved.

In conclusion, I wish to express my sincerest thanks to my teachers, Prof. H. Chiari and Zaufal, in giving me the opportunity to follow this case from beginning to end, and aiding me in the study of the pathologic investigation of the same.

IX.

KELOID TUMORS.

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EAR INFIRMARY.

My interest in this subject was aroused by seeing in a clinical case, a negress, a keloid growth about the lobule of the ear. It had recurred, larger than ever, a few months after removal.

Synonyms. Cheloid, Kelis, Kelos; Fr. Cheloide; Ger. Knollenkrebs.

Description. We have a tumor of varying size, projecting above the level of the skin in a smooth, flat, hard, well-defined mass. In color it is white, pink, or in negroes, varying with the individual color of the skin.

Its extension in claw-like radiations suggested its name. These tumors grow slowly; become paler and harder with age. Exceptionally they may atrophy in old age. Pain is not common. Pricking, burning and itching sensations may occur.

This form of tumor is comparatively rare.

Pathology. It is a variety of fibroma; an affection of the skin occurring in the middle and lower portions of the corium. We have fine dense bundles of white fibrous connective tissue. Blood vessels are few in the centre, but more numerous at border of tumor. Sebaceous glands and hair follicles are pushed to one side by the growth and often atrophy.

Its origin was formerly thought to be in the adventitia of the vessels and perivascular connective tissue (1). Later investigations do not support this theory of origin (16).

Etiology. Two forms have been recognized: the spontaneous or true, and the cicatricial keloid (2) (6). Probably all are cicatricial (5) (23) (3) (4), following some form of injury to the skin. The following have been mentioned: Perforation of ear lobule for ear-rings, scratches, blisters, scalds, burns, leech bites, mosquito bites, briar or nettle stings, acne, herpes or small-pox; in general, any traumatism or condition

leading to scar formation or to vesicular or suppurating eruption. The colored race most frequently suffer. This affection is rare in the very young; usually occurs in middle life; has been observed at all ages (2). All grades of society are subject. Certain families are predisposed. Occurs most frequently in tropics. Is not affected by sex.

Diagnosis. Keloid differs clinically from simple fibroma by elevation above the surface, smooth cicatricial appearance, sharp margin, tendency to form claw-like projections which stand out in relief from the healthy skin, tendency to recur after removal. Morphoea in raised patches may simulate keloid. Morphoea is a circumscribed form of scleroderma. It looks like a piece of old ivory set in the skin. It may be pink, yellow, brown or black. The skin is usually smooth and easily pinched up. It is surrounded by a tinted border of dilated vessels. The ear is not a usual site.

Prognosis. Treatment has been very unsatisfactory. "Excision of entire skin, covering surface with Thiersch's grafts has invariably failed to prevent relapse." The keloid recurs with increased size. Age favors involution and exceptionally spontaneous involution has taken place (1) (2). They usually persist through life. They may remain stationary or slowly increase in size. They do not interfere with the general health.

Treatment. Excision and cauterization are not to be practiced (5). Local applications of iodine, etc., to promote absorption are useless (2). Efforts to relieve by decreasing the vascularity with collodion or pressure have been tried. We are told that electrolysis in very small keloids will sometimes check the growth (1). The generally unsatisfactory results of treatment were shown, however, by the recommendation of Jackson in 1901 in his text-book on Diseases of the Skin, that these growths are best let alone.

Lawrence reported a case in 1898, where after two operations with rapid recurrence, he tried scarification, followed by pressure for several months. This was followed by an apparent cure, when reported, there having been no recurrence in a year (12). Theoretically, this would not seem a desirable method of treatment, and in the absence of further reports can hardly be recommended. Since the development of X-ray treatment, cases have been accumulating that show this to be the most effective treatment yet tried, excepting,

perhaps, that of radium rays. The actinic or Finsen rays, however, are reported to exert no influence whatever (21).

The following reported cases outline the results thus far obtained:

Harsha. (15) Keloid removed three times with recurrence larger than ever, under X-ray diminished to 1-6 size.

Ochsner. (20) Keloid under X-ray diminished to slight thickening.

Pancoast. (17) Keloid of lobule and helix of each ear in female mulatto, aged 27. Eighty X-ray treatments 6 to 10 minutes each. Improvement not marked.

Pancoast. (17) Keloid left auricle in colored female, aged 21. Sixty-five treatments X-rays 10 to 15 minutes each. Thiosinamin internally. Patient declared cured.

Pancoast. (17) Keloid right auricle and neck. Treated to prevent recurrence after removal with knife. Increased in size in spite of X-ray.

Boggs. (18) Keloid treated by X-ray 3 times a week for 6 weeks, twice a week for 4 weeks, occasionally for balance of year. Cured.

Williams. (19) Case with two small keloids. One improved under X-rays, the other more rapidly under radium.

Allen. (21) Three cases still under treatment. After thirty X-ray exposures tumors disappearing but not yet cured.

Morris and Dore. (17) Keloid under X-rays. Decided diminution in growth in some cases and marked relief from pain.

Varney. (8) Keloid recurring after three operations for its removal, under X-ray completely disappeared. No recurrence in one year.

Hyde, Montgomery and Ormsby. (9) Five cases keloid-like scar following burn. Decided softening and thinning but not complete disappearance of scar under X-ray.

Morton. (13) Keloid of neck in scar of variola pustule. Recurring promptly after being twice removed with knife; increasing in size to 2 inches long, $\frac{3}{4}$ inch broad, 1-3 inch high. X-ray three times a week. Thirty treatments. Result, nothing whatever remains of the keloid, the skin is soft and smooth.

Morton. (13) Keloid, length 3 inches, breadth $\frac{1}{2}$ inch, depth $\frac{1}{2}$ inch. Under X-rays for four months, complete cure.

Pusey. (10) Two cases of keloid treated by X-ray. One $2\frac{1}{2}$ inches long, $1\frac{3}{4}$ inches wide, $\frac{1}{2}$ inch high, nearly dis-

appeared in 11 months. The other diminished $\frac{1}{2}$ under irregular treatments.

Summary. Of 21 cases 5 are reported apparently cured, 14 improved, 1 no marked improvement, 1 grew worse under treatment.

Conclusion. The X-rays afford the best method of treatment for keloid yet demontsrated.

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X.

GROWTH OF BONE IN BOTH TONSILS.*

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This case, showing growth of bone in both tonsils, I offer as supplementary to a recent report of a similar case¹ before this section.

These cases are extremely rare, and that two should have come under the observation of one man within such a short period is rather remarkable. A man of 37 applied for treatment in April. He had been suffering with an attack of tonsillitis for five weeks, and said that he had been subject to occasional attacks of much shorter duration than this since he was a child; otherwise he had considered himself healthy and strong. His family history was unimportant. Examination showed the pharynx, and especially the pillars, to be very much congested, the tonsils were moderately swollen and were covered with white specks which seemed to mark the crypts; these specks were confined to the tonsils. Pressure upon the tonsils was very painful, and the patient claimed that he could scarcely swallow even fluids. A smear made from one of these white spots and stained by the Gram method showed the leptothrix buccalis threads and spores in large numbers.

The patient was given an alkaline gargle, and an occasional application of argyrol 25 per cent was made to the tonsils. At the end of two weeks the acute symptoms had subsided, but the distribution of the leptothrix was unchanged. Though the tonsils had receded behind the pillars and were apparently small, there was no doubt about their being thoroughly diseased. I attempted to remove them with the tonsil punch, but found that they were solid masses and could not

*Reported at a meeting of the Laryngological Section of the Academy of Medicine.

(1) Medical Record, Feb. 4th, 1905.

be included in the grasp of the instrument. I then lifted the right mass from its bed with a small tenaculum and removed it with scissors curved on the flat; the left I removed with the wire snare. Each mass was very much larger than I expected to find it, measuring about four centimeters in length and three centimeters in breadth and thickness. They were completely hidden by the pillars, and were so well accommodated in the tonsillar fossa that I have no doubt that in a cursory examination of the throat, they would have escaped observation. For this reason I am inclined to think that the condition occurs more frequently than the number of reported cases would lead one to believe.

The specimens were examined under the microscope by Dr. Wright; both tonsils presented essentially the same appearance. His report is as follows: The horizontal section shows well formed bone with canaliculi and Howship lacunae containing fat and lined with osteoblasts and osteoclasts. There is much fibrous tissue in all parts of the tonsil and very little lymphoid tissue. A number of lacunae lined with keratotic epithelium and filled with keratotic scales are seen, but owing to the action of the decalcifying fluid no threads of leptothrix are distinguishable.

In my former case only one tonsil was involved, and the changes could be traced in the stroma from fibrous tissue through cartilage to bone.

In this instance the changes seem to begin with a keratosis, which is essentially a degeneration, and the bone formation is a later change in the fibrous tissue. The facts in this case go to confirm the conclusions reached in my former presentation of the subject, that bone in the tonsil is a result of retrogressive metaplastic changes in the fibrous tissue carried beyond the usual limits; for not only can the changes be traced to the connective tissue, but its occurrence in both tonsils lends strength to the view that local conditions have nothing to do with it.

It is only necessary to mention that two theories are held to account for this phenomenon. First, that the bone is due to changes in vestigial remains of the second branchial arch, and second, that it is due to metaplastic changes in the connective tissue of the organ.

Here might be mentioned a suggestion made by Dr. Beaman Douglas in the discussion of my last paper, that it might be

possible for foreign bodies introduced into the tonsil to act as a nidus for the development of bone. The writer, however, has been unable to find record of any case originating in this way.

In explaining the tendency to the formation of bone in this locality, it is necessary to assume some special predisposing factor. I have not seen it mentioned elsewhere in the literature on this subject, but it has occurred to me that the *saliva* constantly passing over these tissues undergoing metaplastic changes may furnish this factor. About two-thirds of the solid matter in saliva is calcium and magnesium phosphate held weakly in solution by the chlorides of sodium and magnesium. On the other hand, the inorganic matter of bone is chiefly calcium and magnesium phosphate. Now it seems to me that the tonsils undergoing active tissue changes, might the more easily appropriate from the saliva these salts necessary to the formation of bone. If such is not the case, why is it that in the pharyngeal tonsil which undergoes essentially the same changes we never find bone?

69 West Fiftieth Street.

XI.

A CASE OF MASTOIDITIS COMPLICATED WITH EXTRADURAL ABSCESS, WITHOUT A HIS- TORY OF A DISCHARGE FROM THE AUDITORY MEATUS.

BY SAMUEL IGLAUER, M. D.,

CINCINNATI.

Mr. C. G., age 37, restaurant keeper, consulted me September 6, 1905, complaining of pain in and about the left ear. He had always been well, excepting for severe headaches, which he had had a year previous and which had been partly relieved by glasses. The present trouble began seven weeks ago, after rowing, becoming overheated, followed by exposure to the draughts in a trolley car. He has had earache ever since.

According to his positive statement, his ear had never discharged in all this time. His family physician, who has had him under observation for the past three weeks, reports that he has never seen any discharge from the ear. During the first two weeks patient instilled laudanum and sweet oil into his ear. During the past few weeks patient had been treated by poultices and by tincture of iodine painted over the mastoid.

Status praesens.—Patient complains of earache, and of headache referred to the left frontal region and to the vertex. The watch is inaudible; the voice is only heard close to the ear; Weber's test is referred to the left. There is redness and swelling behind the ear; the posterior auricular fold is obliterated; the mastoid is tender. There is a sinking in of the posterior superior wall of the auditory meatus. The ear drum is of a dull red color; bulges; there is no perforation and no pus in the meatus. The temperature is normal and pulse 84.

Diagnosis.—Acute mastoiditis.

Treatment.—Paracentesis was performed and a few drops of creamy pus came through the incision almost immediately.

Ice bags were ordered over the mastoid. The meatus was packed with gauze. Patient returned next day with free discharge of pus, which had saturated the gauze. There was less tenderness over the mastoid. On the following day patient had a slight chill and a slight rise in temperature, the discharge continuing. He was sent to the hospital. The evening before the operation the temperature was $99\ 3\text{--}5^{\circ}$, the pulse 84 and the respiration 20.

Operation.—September 8, 1905, the simple mastoid operation was performed. The cortex of the mastoid process showed a small perforation leading into the mastoid bone. The mastoid cells were not very numerous and were filled with pus and granulations. These were thoroughly removed and the operation apparently completed when a thin streak of pus was noted coming from the posterior portion of the operation canal. The probe was introduced at this point for about one-half inch. The fistula was enlarged, exposing a cavity about the size of a hazelnut, leading directly to the dura mater covering the region of the sinus. The dura was found thickened and covered with granulations so that the sinus was not visible. About a dram of pus was found in the cavity. This, undoubtedly, was an extra-dural abscess covering the sinus at this point. The wound was packed with iodoform gauze and partially closed with sutures.

The pain in the head disappeared almost immediately after operation, and the patient has (November 17, 1905) practically recovered entirely.

This case is interesting owing to the fact that we had a case of acute mastoiditis without perforation of the ear drum, and complicated by extradural abscess. The only symptoms which might have suggested the latter complication were the severe, radiating pain, a slight slowness of cerebration and a certain nervousness which was attributed to loss of sleep.

XII.

A CASE FOR DIAGNOSIS.

By T. H. FARRELL, M. D.,

UTICA, N. Y.

The case I present for your consideration is of some interest. I have watched it for over five years without making more than temporary diagnoses. It was seen by Dr. F. A. Bosworth, who made a diagnosis by exclusion of leukoplakia, but the subsequent history does not verify the diagnosis.

A. L. F. Deyo, male, aged 53, a farmer, living on the foothills of the Adirondacks, presented himself for treatment December 18, 1900. A year and a half prior to this he began to have sore throat. Ulcers would appear, heal and reappear. Dr. W. M. Gibson, of Utica, found a trace of sugar in his urine, and treated him for diabetes without result. Five months ago Dr. J. H. Glass, of Utica, diagnosed syphilis and put him on anti-syphilitic treatment, pushing it for four months, when he had lost forty (40) pounds and his throat was still sore. In the last month he has had an attack of shingles. His family and personal history is good.

At the time of my seeing him he complained of his throat being uncomfortable and there was pain in swallowing. On inspection his throat was found to be a good color. The right tonsil was the size of a hazelnut, normal in appearance, except for a small, round, superficial ulcer with a white base and a definite margin with a narrow red border. The left pillars and tonsil were red, the pillars thickened and nodular, the tonsil very hard. On the free edge of the posterior pillar were three superficial ulcers like that on the right tonsil, and on its anterior surface was a clean punched out ulcer without specially red margin. At the junction of the posterior pillar with the soft palate was a yellowish spot as if just ready to break down into an ulcer. The epiglottis was red and swollen with a superficial ulcer on the right side.

December 31st. The ulcer on the right tonsil has spread superficially. The left posterior pillar is more swollen and nodular. The three superficial ulcers are larger than before,

the yellow spot has become a superficial ulcer, the deep clean-cut ulcer has healed. Epiglottis looks normal. The right aryepiglottic fold is red and swollen and has a sharply defined depressed ulcer on its posterior surface.

January 3, 1901. The ulcer on the aryepiglottic fold is healed, and the swelling less. The left arytenoid is slightly swollen. The ulcers on the left pillar and right tonsil have spread over a greater area and the tonsil is swollen.

January 11th. Ulcer of right tonsil about the same size. Part of the base consists of a firm, white, closely adherent slough, the removal of which leaves a bleeding surface. Left faucial tonsil and pillars have almost entirely cleared up.

January 17th. Several small white spots have appeared on left posterior pillar and tonsil. These consist of a white elevation rising from a normal mucous membrane—are easily removed and leave a shallow ulcer. A large piece of white slough, which extended deeply into a crypt, in the right tonsil, was removed without bleeding. Slight redness and swelling of the left side of the epiglottis, on which was a small white spot—another white spot at the base of the tongue. Both arytenoids red and swollen. A white spot on processus vocalis of left arytenoid.

January 31st. Larynx and epiglottis look normal. Left faucial pillars and tonsil almost normal. Right tonsil greatly swollen—large, deep ulceration on anterior and posterior surfaces—base tough and white. Right posterior pillar red and swollen. Early in February the patient went to New York and consulted Dr. F. A. Bosworth.

February 19, 1901, Dr. Bosworth writes: I removed the projecting mass on the right tonsil and sent it to the laboratory and had it examined. The report was "Papilloma." This would seem to exclude cancer, lupus and tuberculosis, while Glass' treatment excludes syphilis, it seems to me. My impression at first seeing the case was that it was epithelioma—but there was so little induration that I was doubtful. Accepting the microscopic report, I can make but one diagnosis, "leucoplakia tonsillaris."

You see the obscurity of the case to me, and I merely write the means on which I reached the conclusion.

I have removed all the growth with the snare that I could, and subsequently went over it very carefully with the galvanocautery.

I have no suggestion to make further than to watch the case and, in case of a return of the disease, to destroy it with the galvano-cautery or some chemical agent.

I have seen a few cases of leukoplakia of the mouth—in which chromic acid did better than anything else. The main danger of this affection is that it may change into epithelioma.

March 5, 1901, Dr. Bosworth writes: I know of nothing that promises better for the patches in Deyo's case than the galvano-cautery. The essential thing is that it be thorough. The prognosis in these cases is rather bad. They return and return in spite of everything—and finally they turn into epithelioma. The best promise of arresting the disease is in the galvano-cautery, and this is because the galvano-cautery does its destructive work more thoroughly than any other destructive agent.

My diagnosis, I think, is correct, and yet it was only by exclusion. It is said that leukoplakia is a mouth disease, and does not appear behind the anterior pillars, and yet considering the history of the case—the microscopic character of the growth, and the appearance—I certainly believe it is the only diagnosis. What else can it be? And it recurs in the characteristic way. I would keep it up with the cautery, and, if you do it deep enough, I believe you will stop it.

June 3, 1901, Mr. Deyo writes: I am very glad I can write you that my throat is completely cleared up. I am satisfied that the soreness came from below where I could not see, and that has now healed, and I feel nothing only a little fullness or swelling, which is fast disappearing. I am working hard—and sometimes in the rain—and weigh 150 pounds in shirt-sleeves.

December 20, 1901. Pharynx and fauces clear and smooth. Epiglottis red and swollen with a deep ulcer on the right side and a shallow ulcer on left side. Cauterized freely with electro-cautery.

January 13, 1902. Epiglottis healed; ulceration in right pyriform fossa. Cauterized thoroughly.

January 19th. Right arytenoid red and swollen; ulcer on superior surface; cauterized with electro-cautery.

January 22, 1902, Dr. Bosworth writes: These cases are exceedingly obstinate and trying, as you observe, and requir-

ing the most active measures. I have never known of such a thing as extension into the larynx, and I doubt if it is a complication to be feared. There is recorded the danger of its developing into epithelioma, but I have never seen any such tendency.

November 26, 1902, Mr. Deyo writes: My throat is behaving beautifully and I scarcely know it is sore at all. Have no trouble about eating (only to get enough), and if it continues to improve as it has done lately I think it will be as good a throat as anybody owns. I think under the circumstances that it will not be necessary to go to see Dr. Bosworth until I can take my diploma (the two years' treatment) with me.

November 18, 1905. Since that time Mr. Deyo has had periods of quiet with no appearance of ulceration or inflammation alternating with periods of exacerbation, involving the posterior pharyngeal wall, epiglottis and aryepiglottic folds. The fauces have remained free.

I wrote to a bureau in Washington for all the literature they could find on leukoplakia in the Surgeon General's Library, and received the following:

LEUKOPLAKIA.

The patches are limited to the buccal cavity, and generally found on dorsum of tongue or inner surface of cheeks and lips, but seldom, if ever, on lower surface of tongue or back of anterior pillars of the fauces. They consist of one or more small irregular or oval spots which may become confluent. A considerable portion of tongue alone may be involved, or dorsum of tongue, buccal mucous membrane and the gums one and all may be affected. The first appearance of the white patch is preceded by hyperemia, and subsequently in the early stages a hyperemic areola is found about its borders. Before long the patch itself becomes thickened, sometimes to the extent of 6-8 m.m., and the epithelium which has become hard and dry may be easily removed, or in spots it may be spontaneously exfoliated, leaving the appearance of an ulcer. The surface of the patch is marked by numerous fine lines or furrows which by intersecting each other divide it into small polygonal spaces.

Excessive smoking is reckoned as a cause.

PROGNOSIS.

The duration of the disease varies from a few months to several years. The majority of cases terminate in epithelioma, which runs its course to a fatal issue.

LEUKOPLAKIA.

Moritz Schmidt, in his text-book, "Die Krankheiten der oberen Luftwege," Berlin, says on page 174: A thickening of the epithelium, leukoplakia oris, occurs not only on tongue, called here leukoplakia linguae, but also on mucous membrane, lips and cheeks in the form of mother-of-pearl spots which generally extend over not a little of the mucous membrane. On surface of tongue occur sometimes only small spots, somewhat deep, which may exhibit the mother-of-pearl color more or less.

On the under-surface occur circumscribed grayish white thickenings of the epithelium, which have the greatest similarity to the gray condylomata of secondary syphilis, with which they are all the more likely to be confused, since it is in syphilis, and after a course of mercurial treatment they are most often found. When these gray spots occur on the tongue only, unaccompanied with appearance in other parts of the body, one cannot, according to my opinion, conclude from this alone that active syphilis exists, entirely apart from the fact that they occur in other chronic irritations of the mucous membrane; for example, in smokers who have never had syphilis.

Schmidt adds: "I would remark also that many persons see in leukoplakia a disposition to cancer. This is a point which the general practitioner is better enabled to clear up than the specialist, as he observes the patient from youth up."

The only literature that I have seen, aside from the meagre notices of leukoplakia in the text-books, is an article in the Transactions of this Society for 1902 on "Leukoplakia Bucalis, with report of a case treated with X-rays," by Otto J. Stein.

In summing up he says: "The appearance of the disease as usually first recognized is that of pearly-white or milk-white irregular plaques or patches of varying size, smooth and glistening, causing no discomfort whatsoever, appearing

anywhere on the mucous membrane of the cheeks, lips, gums, tongue, palate and fauces. Later they become more thickened and hence elevated; also, more hardened until they may present a rough and pitted surface, hornified to the feel and markedly elevated. Either one of these two conditions may begin to fissure and finally ulcerate, resulting in a very painful affection."

This is very different from the condition in Deyo's throat. Here the disease did not pass in front of the anterior pillars. The ulcers were preceded by small yellow spots under the surface, or by small white tufts, which were soon thrown off. A peculiarity of the disease is, that while apparently perfect healing takes place in one locality, it breaks out in another not contiguous. He has had long intervals when no evidence of the disease could be seen.

The only treatment that has been of any use, is that suggested by Dr. Bosworth of thorough cauterization, and the more thoroughly it is done the more promptly the healing process.

The patient is here for your inspection and diagnosis.

In discussion, Dr. Theisen of Albany, and Dr. McCaw of Watertown, suggested that it might be a case of Vincent's angina.

XIII.

MUELLER'S VERTICAL NASAL CUT.

BY FRANK B. SEITZ, M. D.,

BUFFALO, N. Y.

Killian's muco-perichondrial elevation and extraction of deflected cartilage and Ballenger's swivel knife have given an impetus to and aided in the perfection of deflected septal operations. We have the Chiari, Hajek, Killian, Ashe and other incisions, but they are used only on deflected nasal septi. The straightening of the nose seems, however, to have escaped especial mention; for I have noticed particularly at the Buffalo meeting that speakers spent their energies on the septum. We should remember that there is a difference between a deflected septum and a deflected nose. Each may exist independently and also together. It is not my intention to add anything original, but to call attention to a valuable adjuvant which already exists, but seems to be overlooked as unimportant. It is the vertical cut in the septum for straightening a nose.

While taking a rhinologic course with Dr. Mueller at Vienna, he casually told the class of a vertical line of interrupted incisions into the cartilage of the septum from the tip of the nasal bones to the floor of the nose. He gave it to the class without any ostentation or claim to originality, gave it as if it were a well-known and common incision; in fact, he did not mention who first used it.

The Mueller cut—I will call it that for want of a better name—consists essentially of slight incisions through the cartilage of the septum running in an interrupted vertical line downward from the nasal bone. The cuts or stabs are made by inserting a curved bistoury inside of the nostril and engaging the cartilage up close to the lower edge of the nasal bone. The tip of the knife is then pushed through and withdrawn, leaving a wound the width of the knife. Now lower the knife about one-eighth of an inch and make another similar stab through the cartilage. Continue down in a straight line to where the raphé joins the upper lip. The unincised

intervals serve to keep up circulation and hasten healing. The nose can now be bent over like a door swinging on a hinge, and can be placed so that its tip will be in a line with the V in the upper lip and a point midway between the eyebrows.

The splint to keep the nose in place is probably well known, but may be recalled here to finish the article. A splint may be made of wood—from a cigar box—one-quarter inch thick, three-fourths inch wide and two inches long, or of a size and shape to fit the nostril. The split can be sterilized, wrapped in bichloride gauze to make it of sufficient thickness to remain in place. It is now pushed into the nostril, allowing about one-half inch to project. It must be placed in the nostril on the side toward which the nose formerly had turned. Now make a hole in a piece of one-inch wide adhesive plaster to engage the projecting end of the splint, draw the nose into a straight line by means of the strip of adhesive plaster attached to the splint and stick the plaster across the cheek to below the ear. If no untoward symptoms arise, the dressing can be left undisturbed from four to six days.

This vertical cut and procedure may be known and practiced by many. I am sure it is used by members of my class at Vienna; but I am equally sure that as it has not been mentioned in discussions and articles, it is not known to many others. It is to reach the latter class that I venture to bring up what may seem to be an old subject.

21 North Street.

XIV.

THE INDICATIONS FOR OPERATING IN ACUTE MASTOIDITIS.

BY PHILIP D. KERRISON, M. D.

NEW YORK.

In determining the relation of surgery to disease, one should deduce one's facts from the cases which have recovered without operation, as well as from those operated upon. Particularly does this seem to be true with regard to the *indications for operating in acute mastoiditis*.

Competent surgeons, usually at one theoretically, often differ materially in practice. Whoever, therefore, feels called upon to dissent even in the smallest particular from the popular conception of what should constitute an indication for opening the mastoid, should have the courage to state his views and give his reason therefore. It is the relative surgical value of what are commonly considered the two cardinal physical signs of acute mastoiditis that the writer wishes to discuss.

To review briefly the symptoms of acute mastoiditis, they may be stated somewhat as follows:

The patient during the course of, or convalescence from, an attack of acute purulent otitis media, may suddenly experience deep seated pain in the region of the mastoid process.

The aural discharge, which has perhaps been gradually decreasing in quantity, may follow one of several courses in order to show that recovery has been interrupted; e. g., it may (a) suddenly cease, this abrupt cessation being accompanied by no amelioration of the patient's condition, and being followed within a few hours or a few days by a still more copious flow of pus; or (b) the discharge may gradually increase in volume until it becomes necessary upon purely physical grounds to assume the involvement of accessory sinuses in order to explain the quantity of pus excreted during the twenty-four hours; or (c) the long continuance of the discharge may of itself be sufficient to warrant the inference of a necrotic focus more

deeply seated than within the small tympanic cavity. With the appearance of mastoid pain, sleep is disturbed, insomnia becoming a more or less prominent symptom; and the temperature, which has run a normal course, or has returned to normal, may become elevated. As corroborating the above symptoms, the two following physical signs have come to be regarded as pathognomonic, viz: (1) Tenderness on pressure over the mastoid; and (2) bulging of that portion of the postero-superior canal wall which immediately adjoins the drum-membrane.

The symptoms to be looked for, then, are *mastoid pain*, with consequent insomnia; *elevation of the temperature*; *certain quantitative changes in the character of the discharge*; *mastoid tenderness*, and *bulging of the postero-superior canal wall*.

The above rather meager clinical picture may be said to comprise practically all the symptoms that are characteristic of an uncomplicated case of acute mastoiditis.

Unfortunately many cases of acute mastoiditis run their course with complete absence of one or more of the above symptoms. That extensive necrosis of the mastoid cells may occur with absolutely no elevation of temperature is a fact now fortunately recognized. Mastoid pain may also be absent, or at least not sufficiently marked to be complained of by the patient. When fever is absent, and pain inconsiderable, the subjective and constitutional phenomena are naturally not very characteristic. Fortunately there is one physical sign which is never wholly absent. Sensitiveness to pressure is probably at the onset always present over some point on the mastoid cortex.

In discussing the surgical value of the two physical signs above mentioned, it will be necessary to refer very briefly to certain points in the anatomy of the bone which bear more or less directly upon the pathology of the disease.

Pain on Pressure Over the Mastoid Antrum.—If we were taught to regard the antrum, not as one of the mastoid cells, but simply as the posterior end of the tympanic vault, our conception of its true surgical significance would be more exact. In the fetus at term, the mastoid process as such does not exist, it being represented by a thin cartilaginous plate; yet the antrum is already an easily demonstrable cavity. In the seventh month of fetal life, also, the antrum can be demonstrated to exist, and at this period of its development, its

walls are formed chiefly by the squamous portion of the future bone. While these facts are now fairly generally recognized by students of tympanic anatomy, their surgical significance is still somewhat obscured by statements in some of the older text-books which refer to the antrum as one of the mastoid cells, and describe the *aditus ad antrum* as a narrow passage by which it communicates with the tympanic vault.

The aditus is not a narrow passage connecting two bony cavities. It is distinctly a constricted portion of one and the same cavity. Careful examination of a large number of bone sections shows the aditus to consist of a comparatively large triangular space, the vertical diameter of which—i. e. measured from the centre of its base above to its inferior angle below—will average not less than 4 to 5 mm. Considered as one osseous space, the antro-tympanic cavity may be described as one having a central constriction, and so bent upon itself that while its roof lies throughout in the same horizontal plane, its floor is lower anteriorly and posteriorly than at the center where encroached upon by the lower margin of the aditus.

The antrum, then, should not be thought of as a distinct bony cavity; nor is it an accessory sinus in the sense that the frontal, ethmoidal, sphenoidal and maxillary cavities are accessory nasal sinuses. For whereas hypersecretion may occur, and frequently does occur, within the nose without flooding these accessory cavities, it is difficult to conceive of any considerable accumulation of fluid within the tympanic vault which will not flow backward into the antrum.

This rather tedious statement of facts prepares the way for the following propositions, viz: (1) *That acute purulent otitis media is probably always attended by an escape of pus into the antrum; and* (2) *That the presence of pus within the antrum is not necessarily an indication of mastoid inflammation.*

These conclusions seem fairly deducible from the mechanical relations of the various parts of the antro-tympanic cavity; and from certain clinical facts now generally recognized. In the living subject the vault is more or less completely separated from the lower portion of the tympanic cavity by the following structures; viz: the neck and processus foliatus of the malleus, the lower angle of the body of the incus; the anterior, posterior and external ligaments of the malleus, and the folds of mucous membrane covering them. With these structures in situ, it would seem more reasonable to assume the mechanical

separation of the atrium and vault, than to recognize the vault and antrum as two distinct cavities. Pus in the vault, therefore, must under pressure pass in the direction of least resistance to the antrum.

Now experience has shown that in the majority of cases of severe tympanic infection, the suppurative process originates within the vault rather than the atrium, in which case it seems obvious that pus accumulating within the vault must quickly invade the antrum. The fact, therefore, that many cases of severe suppurative otitis media recover without having produced any symptoms of mastoid involvement would seem sufficient evidence that pus within the antrum may be reabsorbed without having produced any of the bone changes characteristic of a true mastoiditis.

To epitomize: *Acute purulent otitis media is commonly accompanied by the passage of pus to the antrum; and its presence there on opening the antrum is not necessarily an evidence of mastoid inflammation.*

Admitting the above as a working hypothesis, it is not surprising that marked sensitiveness to pressure over the antrum is present in many cases of acute purulent otitis media. With an acute inflammatory process involving the mucous membrane not only of the attic but also of the aditus and antrum, and with the whole antro-tympanic cavity subjected to the pressure of an accumulation of pus for which there is no adequate orifice of escape, absence of pressure tenderness over the antrum would mean a difference between this and all other regions of the body under like conditions. In other words, antrum tenderness may in such cases denote simply the presence of confined pus. Viewed in this way, this important danger signal is as much a logical outcome of the tympanic lesion as is its rapid subsidence a logical result of free incision of Schrapnell's membrane and other rational measures for the relief of an acute purulent otitis media.

Where antrum tenderness persists in spite of such abortive measures, its significance must of necessity be regarded as more grave.

Pressure Tenderness Over the Mastoid Cells Proper.—In the foregoing remarks, the writer refers only to that stage of the disease in which inflammatory process is confined within the limits of the antro-tympanic cavity. When the pus has found its way into the mastoid cells proper, the disease is by no means

so likely to yield to the simpler surgical and therapeutic measures. The lining membrane of the cells in the lower portion of the mastoid process seems to possess but little power of resistance to the action of infective organisms, and their intracellular bone substance is exceedingly prone to undergo necrosis. The significance of mastoid tenderness must, therefore, vary somewhat with its location upon the mastoid cortex, its gravity becoming relatively greater as it extends downward below the level of the floor of the antrum.

Sagging of the Posterior Canal Wall.—A question which it may be permissible to reopen is the surgical significance of *sagging* or, better stated, of *bulging downward and forward of the postero-superior canal wall*. Are we to continue to regard this as one of the cardinal signs of mastoid inflammation? Is the periostitis upon which this bulging depends due to an extension of mastoid inflammation through that portion of the thick anterior wall of the mastoid process which enters into the formation of the posterior canal wall? Or is it rather an extension of inflammation by continuity of structure along the soft parts of the posterior canal wall from the tympanic vault? The writer believes that in the vast majority of cases this bulging of the postero-superior canal wall is due to an extension of inflammation from the vault, and is not an indication of mastoid inflammation, which may or may not be present. This belief is based upon the following anatomical, surgical, and clinical facts:

(1) *Anatomical.*—(a) A section of the temporal bone, more or less horizontal in direction, and passing through the postero-superior canal wall, shows this to consist of a dense, and often thick plate of bone which should act as a natural barrier to the rapid extension of an inflammatory process from the mastoid cells to the membranous lining of the bony canal.

(b) The intimate structural relation of Schrapnell's membrane to the membranous lining of the posterior canal wall provides a natural pathway for the extension of inflammation by continuity of structure.

(2) *Surgical.*—While complete removal of all diseased bone is the first aim of mastoid surgery, this indication never in acute mastoiditis requires the removal of any portion of the bony plate which separates the mastoid cells from the membranous canal. In other words, the posterior bony wall is rarely if ever diseased. Why then, if this bony partition is not

involved in acute mastoiditis, should swelling of the membranous lining of the posterior canal wall be regarded as an evidence of mastoid inflammation.

(3) *Clinical*.—(a) In cases of *chronic suppurative otitis media* in which extensive destruction of the membrana tympani has occurred, characteristic bulging of the posterior canal wall is never present; yet in such cases the posterior wall of the bony canal as well as the mastoid cells, is often diseased. How is the absence of this physical sign to be explained except by the loss of continuity between the structures of the vault and those of the membranous lining of the meatus?*

(b) There have been many cases of *acute purulent otitis media* which in spite of marked bulging of the postero-superior canal wall, have recovered completely and permanently without having produced any marked signs of mastoid inflammation. Such cases have been repeatedly observed by others as well as by the writer.

Two facts, then, should be borne in mind, viz: (1) that this "sagging of the posterior-superior canal wall," whatever the exciting cause, is the result of inflammatory changes in its periosteal lining; i. e. is dependent upon a true periostitis; and (2) that in no structure of the body is swelling due to acute inflammation more likely to be prolonged than in the periosteum. This is a recognized surgical fact. If, therefore, a somewhat protracted inflammatory thickening of the postero-superior canal wall be regarded as an evidence per se of an acute mastoiditis, many cases may be operated upon in which mastoid inflammation has either never existed, or having been present, has undergone resolution.

The writer wishes to emphasize the fact that not every case of acute purulent otitis media which develops antrum tenderness and bulging of the posterior canal wall is necessarily one of true mastoiditis; and that between the milder grades of tympanic infection and inflammation of the mastoid cells proper there is an intermediate condition—an empyema of the antro-tympanic cavity, which yields quite happily to free incision of the drum-membrance and appropriate after measures. Antrum tenderness may mean, therefore, either a collection of

*In cases of chronic suppurative otitis media in which the upper half of the drum-membrane remains intact, exacerbations of acute inflammation not infrequently give rise to characteristic bulging of the posterior wall.

pus in the antro-tympanic cavity, or the early stages of a suppurative process within the mastoid cells. Which of these two conditions exists can be determined only by the manner in which the symptoms respond to treatment; i. e. their persistence or rapid disappearance after free incision of the drum-membrane and inflamed posterior wall. It is to be noted, however, that even in those cases which go on to rapid and complete recovery, the "sagging of the posterior canal wall" is one of the last symptoms to disappear.

The indications for operating in acute mastoiditis may be summed up somewhat as follows:

(a) Sudden cessation of the aural discharge, other symptoms persisting; deep seated pain in the mastoid region; marked sensitiveness to pressure upon the mastoid *over an area extending well beyond the limits of the antrum*; these symptoms in the presence of a sudden and considerable rise in temperature, would justify an immediate operation.

(b) In the absence of fever the above symptoms, unless yielding promptly, i. e., in 24 to 48 hours, to abortive measures, would constitute a sufficient reason for operating upon the mastoid.

(c) Marked tenderness over the antrum, *persisting four to five days after free incision of Schrapnell's membrane*, would point to necrotic changes within the antrum calling for operative intervention.

(d) Marked variations in the quantity of pus discharged; its maximum flow being apparently too great to be explained by the tympanic lesion; its periods of diminution being coincident with the development of mastoid pain or tenderness (or both). Such a combination of symptoms constitutes one of the most positive indications for opening the mastoid.

(e) Mastoid tenderness having been present and having disappeared, a discharge from the tympanic vault which resists all rational non-operative measures, may by reason of its persistence justify the hypothesis of a necrotic area in the aditus or antrum. In such cases an operation is often the only means of saving the integrity of the organ, and preventing serious impairment of function.

(f) Finally, evidences of mastoid involvement having been present, the development at any time during convalescence of symptoms of septic absorption, e. g., septic temperature, con-

stitutional exhaustion, etc., would in the absence of other concurrent diseases, constitute a positive indication for immediate operation.

It will be seen from the above that the writer recognizes a number of conditions as calling more or less imperatively for operative intervention. He is convinced, however, that a careful observance of the rule implied in the third clause, ("c") will reduce very materially the number of cases requiring operation. That is to say, where tenderness is confined to the antrum and free drainage through the drum-membrane has been established, a delay of 4 to 5 days will in many cases demonstrate clearly the absence of mastoid disease.

Among the "indications for operating" the writer has not included *bulging of the postero-superior canal wall*, because he believes this to be a physical sign of *acute suppurative otitis media*. It is of undoubted surgical value in pointing to a type, or perhaps stage, of tympanic infection, which must receive prompt and vigorous treatment in order to prevent an extension of the disease to the mastoid cells. Its persistence, however, after mastoid tenderness and other signs of mastoid involvement have disappeared, is no indication of mastoid disease, and should not be regarded as an indication for operative intervention.

N. B.—The writer has purposely avoided any allusion to the bacterial character of the discharge as influencing prognosis and treatment. Cases of streptococcus infection often yield quite readily to minor surgical measures, whereas others in which only the milder pus germs are found often prove most severe clinically. Until we can explain, therefore, the varying degree of virulence exhibited in different cases by apparently the same germ, it would seem safer that the question of operation should be decided in each case chiefly by reference to the symptoms and physical signs.

In conclusion the writer would like to cite two cases from his own practice:

Case 1. A. D., a girl 8 years of age, was referred to the writer on January 15th, 1904, by Dr. Howard Gillespie Myers.

Previous history: Measles 2 years ago, no aural sequelae. Has been subject during past two years to somewhat frequent attacks of acute tonsillitis. Breathes normally.

Present attack. On January 5th, developed acute tonsillitis. On the following day, complained of pain in left ear, which

persisted more or less constantly until January 10th, when relieved by spontaneous rupture of drum-membrane. 5 days later, symptoms recurring, I was called in.

At this time, child complained of ear-ache. Temperature 101.6 degrees.

Physical Examination. Whole drum-membrane is red, with pronounced bulging of Schrapnell's membrane; the bulging here is continuous with marked swelling of the soft parts covering the postero-superior wall of the bony canal. Small perforation in postero-inferior quadrant of mt. Marked tenderness over mastoid antrum.

Treatment. Under nitrous oxide anesthesia, the drum-membrane was freely incised—the incision being carried through the posterior segment of the tense membrane, through Schrapnell's membrane into the vault, and thence outward through the inflamed posterior wall. Leiter coil applied to mastoid. Irrigation of canal with bichlorid of mercury 1 in 5,000, ordered q. 3h. Leiter coil removed at the end of 24 hours, and not replaced in spite of the fact that antrum tenderness was still present. From this time the tenderness over the antrum became daily less marked and had entirely disappeared on January 19th, the 4th day after the myringotomy. Other symptoms were much more persistent. The discharge showed but little tendency to diminish. On January 23rd the incision in the drum-membrane having partially closed and drainage being obviously insufficient, the original incision was repeated. Shortly after this, in spite of a rather free discharge, it was thought wise to discontinue irrigation, and substitute the use of dry wicks of sterile gauze carried into the canal and against the opening in the drum-membrane, both of which had been previously cleansed and dried. The wicks were changed at first twice, and then once daily. From this time the symptoms showed gradual but satisfactory improvement. *The persistent sagging of the postero-superior canal wall, however, was a cause of doubt and anxiety to the writer.* Even after the opening in the drum-membrane was closed, and the tense membrane had regained a fairly normal appearance, the swelling of the posterior wall was marked. All other symptoms having disappeared, the writer felt justified in discharging the patient on Feb. 11th, the parents being instructed to report promptly any symptoms of relapse.

Three weeks later, the patient was brought to the office for

examination. There had been no recurrence of aural symptoms. The tense membrane was normal in appearance. Function tested by acumeter and whisper, seemed perfect. The postero-superior wall, however, still showed some thickening. The writer has heard indirectly that there has been no return of symptoms referable to the ear.

Case No. 2. Mrs. D., was referred to the writer on Feb. 17th, 1904, by Dr. S. A. Brown.

Previous history negative.

One week ago, as a sequence of acute rhinitis, patient experienced severe pain in right ear, which was relieved in a few hours, by spontaneous rupture of drum-membrane. The patient is referred to me on account of continued discharge and return of pain. Temperature 103 degrees.

Examination of right ear. Small perforation in postero-inferior quadrant of mt. Schrapnell's membrane bulging, there being no line of demarkation between this and the swollen postero-superior canal wall. Marked tenderness on pressure over antrum.

Treatment. Under nitrous oxid anesthesia the posterior segment of the drum-membrane and the inflamed posterior wall were freely incised. The usual measure, i. e., rest in bed; catharsis; irrigation q. 3. h. with bichlorid of mercury, 1 in 5,000 solution, were ordered. Patient advised that mastoid operation might be necessary. She was seen daily. Discharge at first free, diminishing daily. On February 22nd, antrum tenderness was barely appreciable on deep pressure. One week later the incision in the drum-membrane was completely closed. The swelling of the posterior canal wall, however, had not subsided, and was again a cause of anxiety to the writer, who still shared the popular belief as to its grave surgical significance. This anxiety the patient did not share. She was free from pain, and to all intents in her usual health, and but for a slight impairment of hearing, would probably have regarded her cure as complete. The correctness of this view was demonstrated by the complete subsidence of all symptoms, the inflammatory changes in the posterior canal wall being the last to disappear.

These histories might easily be reinforced by others in which the disease ran a similar course. They suffice, however, to illustrate clinical phenomena, which the writer has observed in a very considerable number of cases. They were selected

chiefly because, having occurred considerably over a year ago, sufficient time has elapsed to justify the conclusion that recovery was complete.

DISCUSSION.

Dr. Edward B. Dench, of New York, said the distinction attempted by Dr. Kerrison regarding the *aditus ad antrum* as connecting the tympanic vault and the mastoid antrum was analogous to whether we called a strait a narrow neck of water connecting two larger bodies, or a constriction of a large body of water. He did not regard the distinction as material.

According to Dr. Kerrison, tenderness over the lower cells was more important, as a diagnostic sign, than tenderness over the antrum. Dr. Dench said that in the past four or five years, in almost every case of acute otitis, especially those complicating grippe, there was tenderness over the lower mastoid cells and none over the antrum until well marked changes in the antrum had taken place. Whenever there was mastoid tenderness, it could always be looked upon as a sign of inflammation. The speaker said he had seen caries of the cells in the posterior wall of the canal occur very early in acute mastoiditis. Its occurrence there depended on the conformation of the cells in the mastoid, as in some cases the posterior wall of the canal was very thick. The posterior wall of the canal was simply the anterior mastoid wall, and it was very frequently affected in acute disease. The speaker said he could recall a number of cases in which the only symptom of mastoiditis was a sinking of the upper, posterior wall of the auditory canal. Clinically, he regarded this as one of the strongest signs that the mastoid was not draining satisfactorily.

Dr. S. MacCuen Smith, of Philadelphia, said that of all the symptoms of mastoid disease, he placed most reliance upon bulging of the posterior wall of the auditory canal. He had never yet seen that sign fail. He did not mean to imply, however, that bulging of the posterior and superior walls was an invariable symptom of mastoid disease, nor would he operate on the strength of that sign alone, although he regarded it as very important. In a case that recently came under his observation, the patient was a child one year old, the daughter of a physician. That child had never had any ear trouble, had never had any discharge, and had never lost any sleep. One morning, the nurse observed a slight swelling back of the ear, over the mastoid. An examination through the external

auditory canal failed to reveal the slightest redness, but there was distinct bulging of the posterior and superior walls, with characteristic redness. The case was operated on the same morning, and to his surprise he found a carious opening through the cortex; the antrum and the mastoid cells were filled with pus.

Dr. J. A. Stucky, of Lexington, Ky., said that while sagging of the posterior superior wall of the canal might be pathognomonic of mastoid involvement, still the reverse was not necessarily true. We might have very extensive involvement of the mastoid cells, with absolutely no abnormal indication of it in the posterior superior wall. The speaker said he had seen several such cases, in which there was a history of ear discharge lasting some weeks, and no bulging of the superior wall at all. The ear in those cases was apparently draining well, but the patients had a septic look and ran a septic temperature, and on deep pressure there were signs of mastoid involvement. In one such case where the patient was operated on, Dr. Stucky said he was amazed at the extensive destruction of bony tissue.

The speaker said that in the section of the country where he came from there was still much room for missionary work among the general practitioners, and even among the otologists. Many of these still waited for this bulging of the posterior superior wall, and he could recall two instances where they waited too long. In both of those cases the patients developed meningitis, and died.

Dr. L. L. Mial, of New York, said that in connection with this subject of mastoid tenderness, as indicative of mastoid inflammation, he wished to mention two cases that came under his observation during the past six months. One was that of a man 23 years old who complained of severe pain in the ear and mastoid. There was excruciating tenderness over the tip of the mastoid, but no bulging or other indications of mastoid trouble. It was finally discovered that he had a badly decayed tooth on the lower jaw of that side, and when this was extracted, all his symptoms disappeared. The second case was that of a child of fourteen years, in which a similar train of symptoms was traced to the same cause.

Dr. Francis R. Packard, of Philadelphia, said that bulging of the wall of the canal was a particularly valuable symptom in cases where there was no discharge. He recalled such a

case in which he was called upon to operate by Dr. A. W. Watson, of Philadelphia. There was no discharge, but on opening the mastoid, it was found to be rotten, and every cell was filled with pus. It was in this class of cases that the bulging was particularly valuable, as it indicated that the pus was penned in and could not get out.

Dr. Edward B. Dench, of New York, said that if the mastoid tenderness persisted for four or five days, he would be inclined to operate. The tenderness very frequently began at the tip of the mastoid, and spread up to the antrum, and it was this last tenderness that was important.

Dr. Philip D. Kerrison, in closing, in reply to Dr. Dench's statement that he had seen necrosis of the bony wall, said he did not see any reason why that should not occur in cases where the process went on to distinct mastoiditis. Personally, he had never seen it. In his paper, he had tried to bring out the point emphasized by Dr. Dench, namely, that bulging of the posterior wall was the very best sign we had that drainage was not perfect. Dr. Kerrison believed that it was an important sign of severe tympanic infection, but did not necessarily point to mastoid inflammation.

In the case reported by Dr. S. MacCuen Smith, the doctor had stated that there was some swelling behind the ear, which everyone agreed was an absolute indication for immediate operation. In Dr. Smith's case, this post-auricular swelling was stated to have been present some days before the sagging of the posterior canal wall was noticed.

Dr. Kerrison said that while much had been written regarding antral tenderness and bulging of the canal as pathognomonic signs indicating operation, he could recall a large number of cases where both those signs were present and disappeared, and the patients made a perfect recovery without operation.

XV.

REPORT OF SEVEN INTRACRANIAL OPERATIONS
WITHIN A YEAR.

BY GEORGE F. COTT, M. D.

BUFFALO.

Since the advent of grippe some fifteen years ago, many more pus cases affecting the middle ear and sinuses such as the antrum of Highmore, frontal, ethmoidal, and sphenoidal, have been reported than before that time. The ear cases occurring during an attack of so-called grippe are sometimes very intractable and yet the influenza bacillus is seldom found. This is explained by claiming that after an acute attack of influenza the mucous membrane is left in a more or less susceptible condition to irritating substances and thereby becomes fertile soil for the various cocci.

The cases which I report to-day, seven in number, all requiring intracranial manipulation during 1904, dated far beyond this period, save one, and therefore could not be counted as caused by that virulent poison.

The histories of the several cases were traced back to early childhood, all of which had been treated at different times for indefinite periods.

Whenever symptoms of severe deep-seated pain were present intracranial involvement was looked for, but if no opening in the roof of the tympanum was found and no other symptoms but pain observed the radical operation alone was done and further developments awaited. When the dura or brain were involved this became manifest sooner or later, when further operative procedure was undertaken. To differentiate between neurosis and true symptoms of meningeal affection was sometimes very difficult and would cause the patient prolonged suffering until another operation seemed justified. Over-enthusiasm for operating must be discouraged, while on the other hand extreme conservatism often leads to grave disaster. The following cases are self-explanatory:

Case 1—Pachymeningitis with Extradural Abscess—

Man aged 30, had been confined to bed several weeks and unable to work for six weeks because of severe pain in the ear; no discharge, but gave a history of chronic suppuration in childhood which had stopped years ago. Diagnosis of pachymeningitis and perhaps pus under dura was made and he was sent to Riverside Hospital for operation. After having inhaled a small quantity of chloroform and before the post auricular incision was made, patient's breathing gradually became shallow until it ceased altogether; pulse could not be felt at the wrist nor the heart sounds heard over the chest. The table was quickly tilted head downwards and artificial respiration performed until I was too tired to continue, when the assistant, Dr. Jones, worked over him until he gave up and I resumed work again; finally our efforts were crowned with success and patient made slight efforts to breathe, which became more and more pronounced until breathing was again regular.

The radical operation was then proceeded with. The suppuration in early life did not last long enough to cause sclerosis as we usually find it, for the lower cells were quite brittle, the deeper part of the bone having become particularly softened. After its completion the roof of the tympanum was chiseled away and the upper part of the bony canal. Pus was found under the dura, which membrane was very decidedly thickened.

While cleaning out the cells, the internal wall of the mastoid process was found destroyed, leaving a circular opening about five-eighths of an inch in diameter.

The whole cavity was packed with gauze and patient made an uninterrupted recovery. The ear became dry in six weeks.

Case 2—Septic Sinus Thrombosis with Epidural Abscess—

Benedict Scynowski, age 12, U. S., of Polish parents. Father and mother, four brothers and two sisters healthy. Boy was never sick until three weeks before; had severe headache which for the most part was confined to the supraorbital region and was constant. On January 1, '04, ear began to discharge. Entered Deaconess Hospital on January 20, with a temperature of 104 and pulse 130. He was treated for two weeks before for typhoid fever, when a change of doctors was made. Dr. Bradley L. Door, under whose care he had come, asked me

to see the patient and be prepared to open the mastoid. I was somewhat late and the doctor had incised the periosteal abscess and evacuated a quantity of pus. The patient did not improve much. I was asked to see him again on January 23rd; the temperature was then taken every four hours; if no improvement took place in one or two days another operation would certainly be necessary. January 25th, being satisfied there were intracranial complications, and having explained the seriousness of the boy's condition to the mother, that he certainly would die without operation but had a chance, although a slim one, with it, she consented. A radical operation was first done; although there was no history of previous ear disease, sufficient evidence was found showing old suppuration such as sclerosis, remnants of drum-head and ossicles. During the chiseling, pus was noticed coming through the roof of the tympanum; a large opening was made, when a quantity of pus was found under the dura. The result did not satisfy me, however, for the temperature indicated involvement of a sinus, presumably the lateral or sigmoid. The skull was opened over the lateral sinus, which was found apparently empty. A sharp spoon was introduced toward the torcular herophyli and the sigmoid knee and a small quantity of pus brought away each time, then pieces of the thrombus were removed until blood flowed from both sources. The sinus was then packed with gauze and the wound dressed in the usual way. The boy was in pretty bad shape after the operation; strychnia and salt solution were injected and hot bottles applied. He rallied nicely, had a fairly good night, but died the next day. Post-mortem examination was not permitted. Although the case was treated as typhoid fever because of the peculiar temperature, still the extremes, with discharge from the meatus and the bulging of the ear with pain radiating over the right side of the head should have at once cleared up the case as showing that there was intracranial mischief.

The following urinalysis, single sample, was by Dr. Schwertfeger:

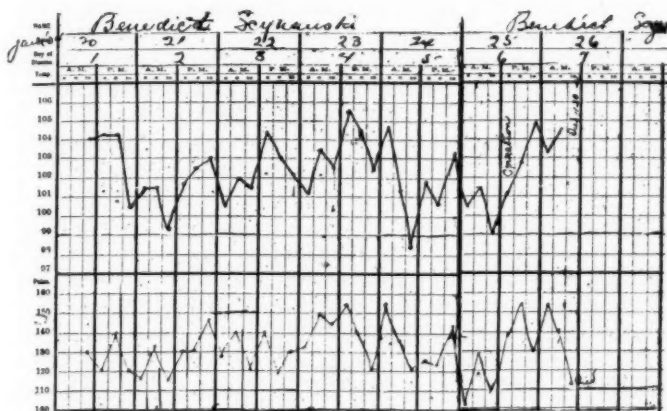
Color	amber.
Reaction	acid.
Odor	urinous.
S. G.	1010.
Sediment	absent.

Albumin	absent.
Sugar	absent.
Microscopic	epithelium and urates.
Ehrlichs diazo test.....	negative.

History After Entering the Hospital—

The first night at the hospital the patient rested quietly and slept some, had a good movement, and vomited several times; Epsom salts given, but vomited. On the 21st of January Dr. Dorr evacuated the abscess behind the ear without much pain.

Following is the temperature chart:



Bowels moved twice that day, brown fluid. At night, no sleep, delirious at times. On the 22nd stool was light brown, containing white curds, followed by three more brown fluid movements; at night sleep at intervals. Next night more quiet but was delirious at intervals. Although quiet during the day time, no sleep at night. On the 25th he slept some and rested quite well after 2 a. m. The night after the operation he was given hypodermically strychn., digitalin, nitroglycerine and whisky, also eight ounces of saline solution; he had a pretty good night and slept at intervals, but died at 11:30 a. m.

Case 3—Dura Attached to Roof of External Canal by Fibrous Band—

Mrs. S., age 38, height a little over five feet, weight 230 pounds; case referred by Dr. Jas. E. King. Had discharge from left ear for many years until seven years ago. Uterus curetted two years ago; since then ear discharged again, which she attributes to the anesthetic. Severe pain over side of head, also deep seated. Treatment of no avail. Radical operation March 3rd, 1903; drumhead and ossicles absent. After this ear was more or less dry, but pain continued and at times became unbearable; occasionally wanders around until found and taken home, all due to the tremendous pain, she claims. Patient was markedly neurotic and for that reason a second operation was deferred; she, however, insisted upon having something done, so on August 10, 1904, 17 months after the radical, the old wound was opened again and sufficient bone of the skull removed to lay bare the dura for three-fourths of an inch; at the roof of the canal a very strong fibrous band was found attached to the dura and the bone which could not be torn from its attachment but had to be cut out with scissors; otherwise the appearance seemed healthy. The wound was then closed and the exposed dura packed with iodoform gauze. The patient has improved perceptibly but is by no means well. At the present writing the ear is dry but there continues occasional pain as before the operation, but her general condition is very much improved.

Case 4—

Mrs. Dr. B., age 51, case referred by Dr. Geo. E. Fell; chronic middle ear suppuration for many years, with pain in ear and radiating over side of head, causing months of sleepless nights and consequently a marked neurotic condition. The radical operation was undertaken, followed by some amelioration, but gradually the pain again became unbearable. Discharge from the cavity never ceased. Hour glass contraction quite external to site of drum head emitting drops of fetid pus. Several months later, patient seemed as bad as ever, but because of her neurotic condition further interference was postponed until finally, several months after the first operation, the patient was again removed to the Buffalo General Hospital on account of a probable pachymeningitis. The old wound was reopened, some tough tissue and half an inch of

the roof of the external canal removed. The dura was coated with organized lymph and the roof markedly roughened, all of which was curetted and the opening packed with gauze. Patient made an uninterrupted recovery and although some pain still remains, she is very much better and able to perform her duties as the mother of eight children, takes things philosophically and has withal a happy disposition. The scalp is still sore to the touch.

Case 5—Sinus in Temporal Lobe—

Mrs. B., age 44, strong, robust and well built, had discharge from left ear about forty years. Called on me for relief, having had severe pain lately. I found carious bone wherever the probe could reach, no vestige of ossicles or drum head left; treated her some months without entirely stopping the discharge or relieving the fetid odor permanently. Operation was advised but stoutly refused until a year after treatment had begun, then her headaches became so severe that she lost considerable sleep and finally consented to go to the Deaconess Hospital, where a radical operation was done; before closing the postaural wound the bone was probed to seek a cause for the severe headaches; at one point the probe entered the skull over the tympanum; bone was chiseled away sufficiently to explore and then a hole nearly one-eighth of an inch in diameter was discovered in the dura; a probe passed through it which entered the temporal lobe one and one-quarter inches. An incision was made along the sinus large enough to easily admit a sharp spoon, the sinus curetted and then packed with iodoform gauze. After three days the gauze was removed and the opening repacked. At the end of two weeks the wound in the brain was allowed to heal and the external wound closed with stitches. Patient made an uninterrupted recovery. Now, four months after operation, patient is quite well, but has had two or three spells of headache referred to the top of her head which, however, passed off again after some hours.

Case 6—Brain Abscess Seven Months After Radical Operation.

Death—

In May, 1903, Miss May L., age 26, was referred by Dr. C. J. Reynolds. She gave the following history: At the age of 2 years she had inflammation of the right ear. At 8 years both ears suppurated; she then remained well until 12 years

old, when suppuration for two months in right ear occurred, also later in left ear; right ear continued suppurating intermittently for a long while, and was treated more or less during that time. When I first saw her she complained a great deal of deep seated pain, radiating over the side of the head. Drum head and ossicles were gone. Patient was fairly well nourished, weighing perhaps 140 pounds, and five feet six inches in height. Family history good; she was the only daughter but had two brothers; father and mother both living. The necessity of operation was explained to the mother and daughter and also the probability of deep seated trouble.

Operation—Patient was sent to Deaconess Hospital and on May 20th, with the assistance of Dr. Reynolds, the radical operation was performed. The second blow of the mallet penetrated the sinus; hemorrhage, however, was readily stopped. After removing the posterior wall of the external canal and the external wall of the attic a sinus was looked for because of the severe pain complained of; this was found paralysis lasting three months, otherwise she made a good recovery and was finally discharged.

After History—Seven months later patient presented herself again, having gained twelve pounds in weight. She was feeling quite well except that there was something bulging in her ear. I found, half an inch from the external orifice, a sac coming down and nearly closing the meatus; this was pressed back but gradually filled again, and upon puncturing, pus escaped. She was again sent to the Deaconess Hospital and the skull opened above the meatus. A large abscess in the temporal lobe was evacuated, its walls curetted, the cavity washed out and lightly packed. Patient made a good recovery, but two months later the cavity filled again. Patient had an epileptic seizure which I think had occurred once before. On February 11, '04, the sac was again evacuated, washed out and packed. She reacted nicely, but after severe pain suddenly became comatose, early the next morning, and died twelve hours later without regaining consciousness. Temperature varied but was never much above 102.

Post-Mortem Examination—This was made sixteen hours after death by Dr. Monroe, the interne who assisted in the last operation. Brain examined only. There was no attempt at healing after first operation nine months previous. Dura

mater adherent where epidural abscess was located and was quite normal in appearance. The brain looked healthy excepting the abscess cavity, which was large enough to admit a finger and over an inch in depth. The immediate cause of coma and death could not be ascertained, but was perhaps due to edema of the ventricles.

Case 7—Sinus Thrombosis—

Girl age 11 years, referred by Dr. McCarty of Geneva, N. Y.; middle ear suppuration since infancy, and while under his care thought it necessary to operate radically to prevent intracranial involvement. I was asked to see the child and decided to act immediately. A typical radical was done and the little girl reacted nicely. Next day temperature and pulse were quite normal, likewise the second day, but the third she showed symptoms of a peculiar character, such as fluctuating temperature, irritability and more or less apathy, while at times she lay very still but would respond when called; occasionally she would move restlessly about the bed.

After consultation with Drs. McCarty and Skinner, both surgeons, of Geneva, it was decided to open the skull at once, which was done; while opening up the old wound a little pinhole leading to the lateral sinus was noticed by the bubbling of gas; this hole was then followed up and enlarged by laying bare the sinus, which was covered with organized lymph. The sinus having been opened, a fatty thrombus was found filling up the vessel from the torcular to the bulb of the jugular vein and was removed with difficulty. The child never came to. Odor of a putrid nature emitted from the recently operated bone, but this looked quite healthy, the odor coming from within the skull. This was a peculiarly sad case, especially for the father, he having buried two entire families, and this was one of two children of the third wife.

ABSTRACTS FROM CURRENT OTOLOGIC, RHINO- LOGIC AND LARYNGOLOGIC LITERATURE.

I.—EAR.

Intracranial Lesions as Sequelae of Chronic Purulent Otitis Media.

M. ALLEN STARR (*Medical Record*, March 10, 1906). The author has analyzed the literature from 1900 to 1906 and has collected 54 temporal, 25 cerebellar and 2 occipital abscesses, in all 81 abscesses of the brain, secondary to otitis, in which an operation had been performed. In 6 of these nothing was found at the operation, but the abscess was discovered at the autopsy. In 42 cases recovery followed the operation. In 39 cases death occurred. Of the cerebellar cases, 16 died.

He thinks that in almost every instance, it is evident that the operation was unduly postponed, in many cases not having been done until five and sometimes eight days after the abscess was suspected. In the majority of cases he thinks the operation had been badly done, the incision being too small or badly located, and drainage being imperfect. Meningitis occurring after the operation was the usual cause in the 39 cases which died, which meningitis might possibly have been avoided if the drainage had been free, the opening in the head large, and the asepsis perfect. In the cerebellar cases, few characteristic cerebellar symptoms were present.

As the abscess is always of uncertain extent, there should be a large field of operation. The head should be entirely shaved twenty-four hours before the operation, cleaned carefully by many scrubblings with soap, alcohol, ether, corrosive sublimate, and a cap of sublimate gauze should be left on all night previous to the operation. The opening should be very large, four by three inches, preferably omega shape, and a flap of scalp and skull laid down, made either with an electric engine or by a small trephine, openings to be afterwards joined by a small saw or gouge. Thus a large field is open and ample room secured before the dura is touched. All hemorrhage from the scalp and from any arteries of the diploe is to be stopped before the dura is opened. The flap is to be protected during the operation by being wrapped in soft sublimate gauze wet repeatedly with hot water at a temperature of 110.

The dura is to be opened with great care. A semilunar

incision is the best, following the line of the opening in the skull. When the cortex is exposed, if the abscess is in sight it can be evacuated by an incision and drained, and turning the patient over so that the abscess shall be down will greatly aid in emptying it.

There may be no abscess in sight, since many of the abscesses lie a centimeter or more beneath the surface. They may be felt, the brain being softer at one point, or may be indicated by the greater venous congestion at one point in the pia. If not, it is justifiable to make a deep incision in the brain. This incision should always be made along the summit of a convolution in its long diameter and the incised surfaces should be separated by two broad, flat spatulae, which thus enable one to get access to the deeper part. The finger should never be thrust into the brain. If a deep abscess is found, it is to be emptied by gravitation. The subsequent drain should be decalcined bone or rubber tissue folded. If the pus found is thick, a gauze drain may act as a plug instead of a drain.

If a diffuse encephalitis is found, and not an abscess, it may be left alone or it may be well to cut the congested and degenerated area out, leaving a cavity. The excision should extend to the limit of the degenerated area so that the walls left are normal brain. Hemorrhage from this may be stopped by sterile gauze tampons held for some minutes in the cavity. Iodoform gauze should never be used about the brain. During the entire operation very hot water should be run constantly over the surface of the brain.

In cases of meningitis and no abscess, a drain may be inserted.

When the operation is finished and the insertion of the drain accomplished, the dura may be united except at the posterior inferior angle or corner of the opening, where the drain is to be brought out. At this point the opening in the skull may be enlarged with the rongeur so that no pressure shall be made on the drain. The scalp is then sewed up except about the drain, and the patient made to lie on the side of the abscess to encourage drainage. The dressings should be changed daily and the drain gradually allowed to be pushed out, but never removed. A very large absorbent cotton dressing held by gauze should be applied over the entire head, as it is important to exclude air from the wound.

Richards.

On the Operative Treatment of Infective Sigmoid Sinus Thrombosis.

RICHARDS (*Archives of Otolaryngology*, Vol. XXXIV., No. 5). As infective sigmoid sinus thrombosis of otitic origin is with rare exception secondary to mastoid involvement, the exploration of the mastoid and the removal of its septic foci constitute the primary step of the sinus operation.

The work should be done rapidly and thoroughly. A peculiar fatality hangs over those who for the second time are subject to operative interference because of the error of delay when the intra-cranial sinuses are invaded by micro-organisms.

With conditions favorable, the sinus should be exposed as low down and as near the bulb as possible, in the hope that the thrombus has not involved the entire vertical limb. If the sinus wall near the bulb is healthy and the vessel's lumen seems filled with blood, a compression plug should be placed across the vein at this point and the remaining sinus groove removed by a chisel. The bone must be removed until the involved dura is encircled completely by a strip of healthy membrane.

That portion of the sinus into which empties the emissary vein, must be exposed, for this vessel may enter as a factor of error in judging the return flow.

When operating on cases of mastoiditis in which symptoms of septic absorption pointing to sinus thrombosis are present it is conservative practice to open the vessel regardless of its appearance, of its feel, or of its pulsation, or if on exposure of the sinus, its appearance is suspicious, we should open the vessel, regardless of the lack of symptoms.

When sinus thrombosis has passed into that stage, where it manifests itself through symptoms indicative of sepsis, it has then become formidable, and a large portion of these cases die regardless of surgical interference.

Pulsation of the vessel or absence of pulsation is of little value in diagnosis and aspiration is not only untrustworthy but it is dangerous.

The sinus is treated as one would an abscess cavity. Slit the external sinus wall and exsect it throughout the entire extent of thrombotic involvement (not merely to that point where we get a free return flow). We should rely not solely upon the return flow, but also upon an examination of the interior of the vein to determine the limits of thrombosis.

Before opening the sinus a small cylinder of gauze is placed across the bulb end of the sinus, but the vessel is not compressed and a second cylinder of gauze similarly placed on the torcular side of the point which has been selected for opening. On incising the sinus, should free bleeding occur the operator compresses the plug on the torcular side and blocks the return flow from above. If the bleeding is still free the assistant quickly blocks the return flow from below by compressing the lower plug. If bleeding continues, we should remember that the emissary vein may be responsible and consequently this vessel should previously have been exposed.

By getting a return flow from below, before we exert pressure over the bulb end of the sinus, we minimize our chances of producing unnecessary pressure upon a vessel which is thrombosed, and therefore of discharging emboli into the general circulation. By opening the sinus before producing pressure upon the torcular side of the point of incision, we create an avenue of exit for any portion of a clot which by our manipulation may be set loose.

In opening the sinus great care should be taken to avoid cutting through the visceral wall; by so doing the subdural space is opened and infection invited, and in children, through the act of crying, through sudden increase of intra-cranial pressure, cerebral hernia is possible.

If after the vessel has been slit freely open, as far down toward the bulb as the bone removal permits, we get an insufficient flow from below, we should immediately proceed with a jugular resection and make no attempt to curette the thrombus from the bulb before the removal of the vein. In exposing the jugular vein, we should endeavor to ligate it as low down in the neck as is possible. After removal of the jugular, a bent curette should be inserted into the bulb end of the sinus and such portions of the thrombus as can be detached should be removed. During this manipulation, pressure should be made over the upper end of the internal jugular vein of the opposite side, as aspiration of particles from the involved bulb might occur through this avenue.

Campbell.

The Indications for Operating in Acute Mastoiditis.

PHILIP D. KERRISON (*Medical Record*, October 28, 1905.)
The author regards the aditus between the tympanic vault and

the antrum as a constricted portion of one and the same cavity and not a narrow passage connecting two bony cavities, and that the antrotympanic cavity is one osseous space which may be properly described as one having a central constriction, and so bent upon itself that while its roof lies throughout in the same horizontal plane, its floor is lower anteriorly and posteriorly than at the center where encroached upon by the lower margin of the aditus. Hence, as acute purulent otitis media is probably always attended by an escape of pus into the antrum, this presence of pus within the antrum is not necessarily an indication of mastoid inflammation. Neither is marked sensitiveness to pressure over the antrum as is proven by its rapid subsidence as a result of free incision of Shrapnell's membrane and other rational measures for the relief of an acute purulent otitis media. The author does not regard sagging of the posterior canal wall as one of the cardinal signs of mastoid inflammation, as has been so often said, but thinks in the majority of cases that this bulging of the postero-superior canal wall is due to an extension of inflammation from the vault, and bases this belief on the following anatomical, surgical and clinical facts:

1. A section of the temporal bone, more or less horizontal in direction, and passing through the postero-superior canal wall, shows this to consist of a dense, and often thick plate of bone which should act as a natural barrier to the rapid extension of an inflammatory process from the mastoid cells to the membranous lining of the bony canal.

2. While complete removal of all diseased bone is the first aim of mastoid surgery, this indication never in acute mastoiditis requires the removal of any portion of the bony plate which separates the mastoid cells from the membranous canal.

3. In cases of chronic suppurative otitis media in which extensive destruction of the membrana tympani has occurred, characteristic bulging of the posterior canal wall is never present; yet in such cases the posterior wall of the bony canal, as well as the mastoid cells, is often diseased.

He sums up the indications for operating in acute mastoiditis as follows:

1. Sudden cessation of the aural discharge, other symptoms persisting, accompanied by deep-seated pain in the mastoid region and marked sensitiveness to pressure upon the mastoid over an area extending well beyond the limits of the antrum.

2. In the absence of fever, the above symptoms, unless yielding promptly, in 24 to 48 hours, to abortive measures, would constitute a sufficient reason for operating upon the mastoid.

3. Marked tenderness over the antrum, four or five days after free incision of Shrapnell's membrane.

4. Marked variations in the quantity of pus discharged; its maximum flow being, apparently, too great to be explained by the tympanic lesion; its periods of diminution being coincident with the development of mastoid pain or tenderness (or both).

5. Mastoid tenderness having been present and having disappeared, a discharge from the tympanic vault, which resists all rational non-operative measures, may, by reason of its persistence, justify the hypothesis of a necrotic area in the aditus or antrum.

6. Evidences of mastoid involvement having been present, the development at any time during convalescence of symptoms of septic absorption.

He details two cases illustrating conservative treatment.

Richards.

A Case of Cerebral Abscess of Otitic Origin—Operation—Apparent Recovery—Relapse—Operation—Death—Autopsy.

HILL HASTINGS (*California State Journal of Medicine*, October, 1905). Mastoid operation for acute middle ear inflammation done October 6, 1904, microscopic examination of pus showing streptococci. On the twenty-first day, patient was doing housework and the mastoid wound was entirely healed. She remained normal up to December 7th, when there was complaint of severe headache, followed by vomiting and semistupor. December 16th, mastoid wound reopened. Dura uncovered; apparently normal. Aspirating needle pushed directly upward and a little forward to the extent of about $\frac{3}{4}$ inch into the lobe above the antrum, and greenish-yellow odorless pus found. Opening enlarged with a knife. Pus evacuated. Sterilized gauze wick dressing. Immediate improvement followed. Rubber drainage was substituted for the gauze wick two days later. Drainage was continued until January 3rd.

January 26th, six weeks later, mastoid wound again healed, patient free from pain, doing light household work. Sight

good, but a fuzzy optic disk persisted. Two days later there was sudden return of sick headache and vomiting. Mastoid cavity was again opened in the same direction as before. Firm resistance was met at the depth of over one inch, when the needle was felt to enter a cavity, and some thick pus escaped into the syringe. The cavity was opened with a long flat-bladed knife, and as before, fluid pus escaped; altogether a teaspoonful. The external opening was enlarged, the cavity gently irrigated, and the wound loosely packed with iodoform gauze.

As the general symptoms were not improving, another search was made four days later, February 4th, and this time the main abscess cavity was found and opened with the knife at the depth of about two inches. Over $2\frac{1}{2}$ teaspoonfuls of greenish-yellow pus escaped rapidly, evidently from considerable pressure. A large external opening was then made, sufficient to insert the little finger. There was temporary improvement following this operation; several small pockets of pus being found at the time of the dressings and opened. But the general condition again became worse; stupor, gradually increasing to coma, developed, and death resulted three and one-half weeks later.

At the autopsy opposite the openings already described there was found on the right side of the superior longitudinal fissure, on the upper surface of the frontal lobe, a large subdural collection of coffee-colored fluid, about $1\frac{1}{2}$ ounces in amount. This abscess or cyst was circumscribed, and corresponded to the surface of the superior frontal convolution. The underlying brain tissue was not softened or apparently diseased. Two small abscesses, the size of a pea, were found in the anterior portion of the temporo-sphenoidal lobe, in front of and below the main abscess cavity, with which there was no fistulous connection. The main abscess cavity was free of fluid pus. Death probably resulted from the subdural collection of pus and extravasated blood on the upper surface of the brain, the infection being carried through the lymphatics along the course of the sulci.

Richards.

Electrolysis in the Treatment of Chronic Eustachian Stenosis.

HOPKINS (*Archives of Otology*, Vol. XXXIV., No. 6.)
Setting aside those obstructions to inflation which are due simply to the accumulation of more or less viscid

fluid in the tube or about its pharyngeal opening, we find, in general, that inability to inflate the middle ear is due to stenosis of the Eustachian tube—a stenosis which may be either hypertrophic, that is, edematous in character, or hyperplastic. Simple inflation will generally relieve the former, dilatation is demanded in the latter.

Objections to the use of electrolysis for dilatation is largely due to faulty method. One cause of failure is the disregard of the diseased condition of the naso-pharynx. It is necessary to remove adenoids, nasal spurs, polypi or enlarged turbinates in order that the chronic catarrhal condition of the naso-pharynx shall be reduced to a minimum.

One must sterilize instruments, cleanse the nose and naso-pharynx and as a preliminary inflate the tube to relieve it of the mucus and pus which may be lodged therein.

The bougie should be attached to the negative pole and the current tested before being applied. The current must be turned off before the bougie is introduced into the catheter, and after its use must be turned off again before the bougie is withdrawn from the catheter. (The current, however, must be continued while the bougie is in the Eustachian canal.)

After the bougie has been used, inflation must not be employed at that sitting on account of its liability to cause subcutaneous emphysema. If by ill-chance the bougie has made a false passage and blood is found on the bougie upon its withdrawal, it is well to make an application of 8 per cent nitrate of silver solution to the mouth of the tube as a precaution against septic infection.

The passage of the bougie through the Eustachian canal should be made slowly and carefully with not more than 1 milliampere of current until the point of obstruction is reached; then the current may be increased to 2 or 3 milliamperes—rarely to 5—and the bougie advanced with firm and steady pressure until the stricture is passed, while the middle or the ring finger is held against the catheter to prevent any sudden advance of the bougie in case the stricture gives way unexpectedly soon. Then with the same slow motion pass the bougie on until it begins to enter the middle ear.

Begin dilatation with the smallest bougie, No. 1 (French), i e., 1-3 of a millimeter in circumference, use it at intervals of two to four weeks until it is very easily passed and according to the effect produced on tinnitus and deafness and the ease with which inflation is obtained.

After three months or more the next larger bougie is used, going up to 2, 3 and even 4 (French).

The nasal spray is employed daily, and two or three times a week the tube is inflated with a medicated vapor.

In the case of the harder, firmer stenoses, there is a greater inclination to subsequent contraction and it will be necessary to repeat electrolysis every six to eight months.

Campbell.

A Case of Infective Lateral, Sigmoid, Superior Petrosal Sinus and Jugular Thrombosis—Operation—Recovery.

JOHN D. RICHARDS (*American Journal of the Medical Sciences*, February, 1905). This case is one in which the infective thrombosis was of otitic origin, in which the clot extended from the torcular Herophili to the junction of the internal jugular and facial veins, and in which there was prior to the operation neither chill, remitting temperature, nor sweat. A beginning papillitis in the opposite eye was the chief sign pointing to intracranial involvement.

Two operations were done. At the first it was necessary to remove the overlying sinus groove from a point slightly beyond the knee on the torcular side to a point near the jugular bulb; also the bone anterior to the total anterior border of the descending sinus limb for half an inch. Posteriorly it was necessary to make a second perpendicular incision to the original curvilinear incision, peel back a hand-shaped flap, and remove a considerable portion of the occipital bone, thereby exposing the anterolateral aspect of the cerebellar dura.

The case not doing well, the jugular was next ligated at the sternoclavicular joint, and resected. The sigmoid sinus was next curetted. When reaching the region of the sinus knee it was seen that the superior petrosal sinus was occluded. A return flow from this source was not obtained. Incision was next made out to the torcular, the scalp retracted and a canal in the skull corresponding to the external wall of the lateral sinus made. It was found entirely filled with thrombus. Not considering it safe to pass any instrument into the torcular for fear of dislodging the distal end of the thrombus and having it returned as septic emboli through the opposite side into the general circulation, it occurred to the author to block the opposite jugular for the purpose of creating a reverse pressure upon the torcular end of the thrombus, with the hope of dis-

lodging it. This was done, and immediately there followed a slight spurt of blood, and the extrusion of a thin, small, squeezed-out, liver-colored clot, about one-half inch in length.

As a result of this experience he thinks that when attempting to curette a thrombus from the region of the bulb, pressure should be made not only over the internal jugular of the corresponding side, but over both internal jugulars. The aspiratory influence of inspiration is thus more effectually eliminated and the backward pressure noticeably increases. By compressing the opposite vein immediately prior to its fellow, the venous system of that side becomes primarily congested, and consequently emboli would not so readily be forced through the communicating veins to the opposite circulation.

Richards.

Double Mastoiditis Complicated by an Intercommunicating Suboccipital Abscess.

Hirtz (*Archives of Otology*, Vol. XXXIV., No. 6). A man aged 57 had a copious, fetid, purulent discharge from the left ear. There was sagging of the posterior-superior wall of the auditory canal and a large perforation of the Mt. above the short process. The mastoid over the antrum was extremely sensitive to pressure. A noticeable peculiarity was rigidity of the neck, and pain complained of, upon forcible rotation of the head. Temperature, 100° F.; pulse, 98.

A radical mastoid operation was performed and recovery was apparently rapid, but stiffness of the neck persisted. About two weeks later, after a night of dull earache in the right ear, a paracentesis was done with negative results. Four days later slight edema was observed over the right mastoid and pressure over the antrum caused increased pain in the neck. This mastoid was opened, found to be extensively necrotic with a large sequestrum involving the inner table over the lateral sinus. For the next month the mastoid wounds were clean and granulating nicely, yet the stiffness in the neck made it impossible to turn the head. While examining the neck by deep pressure over the site of the occipital artery on the right side, pus was forced into the right mastoid wound cavity and further investigation showed that the pus came through a small opening in the innermost part of the antral floor. A probe was passed fully an inch in a downward and forward direction, and its removal was fol-

lowed by a copious flow of thick, creamy pus. The right mastoid wound was reopened, the incision carried backward as far as the lambdoidal suture and the base of the occipital bone carefully exposed. A blunt probe revealed a pocket of pus beneath the occipital attachment of the deep muscles of the neck. While this pocket was being explored, pus began to flow from the external meatus of the left ear, at first clear pus, then bloody and later watery during the flushing of the wound on the right side.

A collection of pus later formed in the left occipital region, corresponding to the region on the right which had been previously drained, and after being widely opened and packed the wounds slowly healed by granulation.

The case is undoubtedly of the class known as Bezold's mastoiditis, but differs from the usual form in that it traveled laterally along the under side of the occipital bone, beneath the periosteum, parallel with the muscular insertion, and did not appear on the surface behind the mastoid apophysis.

Campbell.

A Study of the Disturbance of Function in Acute Perforative Otitis Media.

OSTMAN (*Archives of Otology*, Vol. XXXIV., No. 4).

Range of hearing.—In a series of 10 cases, in all but one instance, the high limit of perception was reduced, in two being as low as d^8 , and an elevation of the low limit was noted in every one of the cases. The normal limits, both for low and high tones, were again reached after the inflammatory symptoms subsided. The elevation of the low limit is explained by a diseased condition of the sound-conducting apparatus and a consequent poor conduction of low notes. The lowering of the high limit is believed to have its cause in disease of the labyrinth.

Clinically we may conclude that the greater the extent of the reduction of the upper tone limit, and the longer the reduction, the less the probability of a rapid recovery from the disturbance of function and the less the probability of the disappearance of the subjective noises.

Time perception.—Tests made according to the routine suggested by Hartmann to determine the disturbance in the time perception for the octaves C— c^4 showed that the lower octaves were most affected. For the high octaves, the time perception

was shortened in nearly every case, but it was rapidly regained in all but two cases.

It was also observed, that the diminished time perception for the higher octaves stood in direct relation with the subject noises. This would justify the conclusion that the two symptoms are associated, and that they have a common cause, probably circumscribed pathological changes in the cochlea.

Hearing distance for speech.—This method is unreliable, nevertheless a certain relation was found to exist between the decrease in the hearing distance and the lowered upper range of perception for the Galton whistle, as well as a lessened time perception for the higher tuning forks (c^3 and c^4) which would suggest a common cause of these disturbances, viz., a diseased labyrinth.

Weber's test.—In all cases the tone of the tuning-fork on the vertex was most distinctly perceived in the affected ear. Normal conditions were regained in less than half of the cases.

Rinné's test.—Throughout the entire course of all of the cases, a lengthened perception through the bone for the C fork was observed, and in two cases it persisted permanently. The time of perception reached its maximum during the last stages of the otitis and not at the height of the disease, when the air perception was shortened in duration.

Campbell.

Seven Cases of Thrombosis of the Lateral Sinus; Ligation of the Internal Jugular; Recovery in All.

EUGENE A. CROCKETT (*Transactions American Otological Society*, 1905). In all of these cases, for the details of which the reader is referred to the original paper, the internal jugular was tied but not resected, the author regarding the complete removal of the thrombosed portion of the vein unnecessary except, perhaps, in very extreme cases.

After establishing the presence of a thrombus by incision or exploratory puncture, it has been his practice to tie the internal jugular at a point below the thrombus, or through a firm red thrombus and below the point of softening. Two ligatures are then placed about the vein and the portion between cut out for microscopical examination. The ligatures of the upper portion of the vein are brought out through the neck wound and form a natural drainage tube; the neck is

otherwise sewed up. The lateral sinus is then opened and curetted out and a gauze wick drain placed in it.

He has had eleven consecutive cases which have recovered, making a much better showing for the operation than in the simple removal of thrombus from the lateral sinus without ligation. In simple cases ligation of the internal jugular may be done in ten minutes without any shock to the patient. If, however, there is extensive cellulitis in the neck and infected swollen glands outside and inside the sheath of the vessels, it may take from forty-five to sixty minutes and be an operation of great difficulty.

The ligation should always be done early, that is, before the patient has had more than three or four days of high temperature and chills, and before metastasis. Done at this time, recovery may be regarded as practically certain.

Among the early symptoms, beyond chills and high temperature, he regards optic neuritis as the most diagnostic, and thinks it occurs much more frequently in thrombosis than in cerebral abscess or meningitis. The cording in the neck and tenderness along the jugular occurred in only two cases and in all was due to the presence of infected glands near the sheath.

Richards.

Report of a Case of Panotitis Resulting in Meningitis, with Pathologic Findings.

DIXON (*Archives of Otolaryngology*, Vol. XXXIV., No. 6). A nurse, aged 47, six weeks previously developed an acute otitis media. This apparently had run its course and she was being treated for the resultant deafness. Four days prior to admission to the New York Eye and Ear Infirmary during an "examination of the left ear with a probe" she was seized with great weakness and dizziness. There was no chill and no vomiting at this time.

On admission there was on the left side an acute otitis media with slight discharge. No mastoid tenderness. Compression of Siegel's otoscope, when in the external canal, caused marked vertigo. During the three following days there was vertigo, nausea and elevated temperature. On the fourth day she had a chill, mastoid tenderness developed and temperature rose to 103.7° F. There was great pain in the back of the neck along the spine; meningitis had developed. Death supervened on the sixth day.

On autopsy there was marked purulent lepto-meningitis over the superior surface of both hemispheres. The process was, however, more marked at the base of the brain. On removal of the dura, pus was found on the inner aspect of the superior semicircular canal ridge, and the bone was carious at this point. There was pus in the left sigmoid sinus, mastoid and internal auditory canal, and an oval opening 1.5x1 mm. existed in the tegmen antri.

The stapes was partially dislocated and pus passed freely around its foot-plate from the tympanum to the vestibule. There was considerable pus in the perilymph spaces of both vestibule and semicircular canals. The mucous membrane of the tympanum was enormously thickened and the cavity filled with pus. On section of the cochlea, the scala tympani was filled with pus, less was found in the scala vestibuli and there was little or none in the scala media.

The infective germ was Friedlander's pneumococcus. The tract of infection to the meninges appears to have been through the oval window to the vestibule, thence to the vestibule nerves and along the sheath of the seventh pair. *Campbell.*

Report of Two Cases of Mastoidectomy, Sinus Thrombosis, Ligation and Resection of Jugular Vein—Recovery.

MCKERNON (*Archives of Otolaryngology*, Vol. XXXIV., No. 4).

Case 1. A male child, aged 26 months, had an acute otitis one year ago. Two days after a rupture of the left Mt., the right auditory canal was found filled with muco-pus, the Mt. was bulging and a small perforation found in the posterior-inferior quadrant. A smear showed staphylococcus infection. After paracentesis the temperature fell from 102° F. to 99° F. On the fifth day after paracentesis, temperature rose to 103.2° F., and there was beginning right mastoid involvement. On the sixth day the mastoid was opened and a few drops of pus found in the antrum. Ten days thereafter pyemic symptoms developed. Flabby exuberant granulations appeared over the sigmoid groove. The sinus was exposed from above the bulb to one inch posterior to the knee. It was opened and a clot and broken-down material expelled. Free hemorrhage was established at both ends. As conditions were unimproved five days later, the jugular and one inch of the facial vein were resected. The vein contained a clot for 1½ inches below the skull. Recovery from this time on was uninterrupted. (A good rule is

to ligate the vein in every case of purulent sinus involvement.—Abstractor.)

Case 2. A woman, aged 30, developed an acute otitis, following a partial turbinectomy, in which most profound septic infection followed. Paracentesis released pus which contained a large number of streptococci and a few pneumococci. Mastoiditis developing, the bone was opened. Pyemic symptoms developed and a diagnosis of sinusitis was made. Six days later the sinus was exposed from bulb to torcular. The overlying bone was dark, almost black in color. The dura was whitish-yellow and lustreless. Disintegrated clot and pus was removed. Thereupon the internal jugular was ligated and resected. Some enlarged glands adjacent the vein were also removed. The subsequent history was uneventful. Healing was rapid.

Campbell.

Some Experiences of the Operative Treatment of the Middle Ear Complications of the Exanthemata.

A. K. GORDON (*Journal of Laryngology*, Oct., 1905). This paper forms one in a series of worthy contributions upon a common subject, read before the Otological Society of the United Kingdom, last June. The writer, the Medical Superintendent of the Monsall Fever Hospital, in England, calls attention to the large number of ear affections in connection with such infectious diseases as scarlet fever. In the city of Manchester, England, as high as 20 per cent of scarlet fever cases had ear complications. From information received from other aurists, he is led to believe that three-fourths of the cases operated upon by them, resulted from an uncured scarlatinal otorrhea. The lack of attention which the ears of the scarlet fever patient ordinarily receives is dwelt upon; even cases of this affection where a cure of all discharge is reported, often suffer from a relapse after a return to their home. To prevent such dangerous sequelae: First, the removal of all adenoid disease is advocated, even in the acute stage, if necessary. Second, the avoidance, if possible, of infection by means of dirty syringes and unsterilized hands. Rubber gloves and glass syringes are to be employed as a means of preventing this.

An early enlarging of the perforation of the drum membrane is recommended to secure proper drainage. This, too often, has proved disappointing and as a means of securing

better drainage, the writer has during the last six months performed the radical operation in eighteen cases. The results, both as regards cessation of the discharge and the subsequent hearing, have been satisfactory. He is not prepared to recommend such radical procedure as a routine method of treatment, but would urge that patients should not be allowed to leave the hospital with uncured otorrheas. *Harris.*

Partial Turbinectomy Followed by Acute Otitis, Mastoiditis, Sepsis; Paracentesis, Mastoidectomy, Ligation and Excision of Internal Jugular Vein—Recovery.

CHARLES H. KNIGHT and JAMES F. MCKERNON (*Medical News*, November 18, 1905). Four days after the removal of the anterior end of the right middle turbinate, there having been some systemic depression and febrile reaction on the first two days, the patient was seized with sharp pain in the right ear, for which paracentesis was done. The next day there was decided tenderness over the mastoid, which increased so rapidly that mastoidectomy was done forty-eight hours after incision of the tympanum. Streptococcus was present and every mastoid cell involved in the suppurative process, the whole inner table of bone being of much darker color than is usually found, while the bone over the sigmoid groove was almost black.

The case did badly, there being constant elevation of temperature, not very high, however, until the tenth day, when the temperature rose to 103.8 and there was headache and pain in the vertex. On the twelfth day a diagnosis of involvement of the sinus was made, but owing to the patient's condition, the operation was not done until eighteen days from the time of the mastoid operation, the temperature in the meantime ranging from 104 to 97. Operation was now done and the sinus exposed to just above the bulb, almost back to the torcular. A clot was removed from the knee, and in the lower part of the vein was a disintegrated clot. Owing to the presence of this the internal jugular vein was ligated and resected, the lower point of ligation being below the clavicle, the upper at the exit of the vein from the skull. Both the facial and thyroid veins were also thrombosed about an inch from the internal jugular. The walls of the vein and the glands all contained large numbers of streptococci.

Following the opening of the sinus and the ligation of the vein, recovery was uneventful. *Richards.*

The Lines of Treatment in Preventing Acute Middle Ear Suppuration from Becoming Chronic.

W. MILLIGAN (*The Journal of Laryngology*, Oct., 1905). In Milligan's opinion, the explanation for the large number of chronic cases of septic middle ear diseases is for the inadequate and faulty treatment of the acute condition.

Chronicity to his mind is not a question of the duration of the disease, but when proper treatment fails to relieve the acute condition. One form of the faulty treatment for the acute trouble is the use of the ear douche carrying infection into the mastoid cells. The greatest importance is attached to paracentesis of the drum membrane as a means of securing the proper drainage. Milligan is inclined to attach considerable importance to the particular form of the infection, believing that where it is streptococcal, chronic diseases and intracranial diseases are more apt to follow. The removal of all forms of nasal and pharyngeal obstruction is essential to the avoidance of a chronic condition. This he is in the habit of doing as soon as the patient's temperature has fallen to normal and remains so for a period of five days. The persistent recurrence of pus in the middle ear after removal is an indication of a pus reservoir in the antrum. A case of acute suppurative otitis media, which has resisted an incision of the drum membrane and thorough drainage for a period of three weeks, calls for an opening of the mastoid to secure better drainage. In a series of fifty cases where this rule was followed, without other evidence of mastoid disease, the results have been uniformly successful. No importance is attached to the temperature chart; the condition of the pulse is regarded of greater value.

Harris.

Brain Abscess—Operation—Recovery.

PHILIP HAMMOND (*Boston Medical and Surgical Journal*, January 25, 1906). The patient, 41, said to have had a discharge from the right ear for six weeks, one year previous. Severe pain in the right ear last seven days; no discharge; mastoid tenderness three days; no vomiting, dizziness or chills. Right drum bulging, no perforation, slight mastoid tenderness. Drum incised. Patient placed in bed, ear douched, ice coil. Two days later, found on bath-room floor unconscious. Labored breathing, slow full pulse. Recovered consciousness later. Day following vomited several times. Became dizzy. Some pain over

the right side of the head. Pupils equal, contracted to pin points. Foul odor to the discharge from the ear. No changes in the eye. Mastoid operation done day following. Cortex sclerosed to such a depth that all attempt to reach the antrum was abandoned. The mastoid tegmen was removed, permitting the escape of a quantity of very foul pus. Necrotic area discovered extending through the roof of the middle ear, and over this a small perforation was found in the dura. A director passed through this hole allowed a large amount of foul pus and disintegrated brain tissue to escape. The opening enlarged, probe passed 2 to 3 cm. into a large cavity in the temporo-sphenoidal lobe. The dura was then elevated away from the base of the skull and the whole roof of the temporal bone taken out. A wick of iodoform gauze was passed into the cavity in the brain, and the mastoid opening packed with the same material.

The patient did well after the operation. The drainage proved sufficient and there was no hernia. He was up and about the ward two weeks after the operation, and was discharged six weeks later, general condition being excellent and the hearing of the affected ear practically normal.

Richards.

A Case of Acute Meningitis—Operation—Recovery.

E. A. CROCKETT (*Boston Medical and Surgical Journal*, January 25, 1906). There was a history of more or less constant headache for two months, discharging ear since childhood, with nausea, vomiting and vertigo. The patient was brought to the hospital semi-comatose and general appearance gray and septic. There was nausea, vomiting, severe occipital, frontal and right parietal headache. Temperature 102. There was double optic neuritis. The right ear exuded foul smelling, caseous pus and was completely filled by a large polypus projecting beyond the concha. After the polypus was removed a large amount of bare bone was felt in the tympanum, and a bent probe could be passed into the middle cerebral cavity. The skull was then opened with chisel and rongeur, an opening about 2 cm. in diameter. The dura bulged but did not pulsate; was opened with considerable escape of cerebrospinal fluid, distinct yellow lines or pus being seen parallel with the vessels on the surface of the brain. Probe was passed downward, forward and backward to a depth of 3 cm. and nothing found. Gauze drain

was then placed inside the dura and pushed down towards the petrous portion of the temporal bone, the other end brought out through the external skin flap, which was then sutured.

Recovery was rapid and uneventful, the patient being discharged from the hospital at the end of three weeks.

The author believes that many cases of acute suppurative leptomeningitis would recover if operated on at once and a drain put into the subdural space. The cerebrospinal exudate along this drain would relieve the increased cerebrospinal pressure which is what kills most of the patients. In this patient the mastoid was not opened at all for the reason that the infection seemed plainly via the roof of the tympanum.

Vertigo.

A very exhaustive study of vertigo is found in the August number of the *Journal of Laryngology, Rhinology and Otology*. Horsley touches upon the localization of lesions giving rise to vertigo. He maintains that the center of orientation is in the temporal lobe, in proof of which his extensive experimental and pathological observations are offered. This region is directly connected with the cerebellum by Türck's bundle. Apart from the various concomitant affections, such as hemianopsia, which assisted in the clinical localization of the site of the vertigo-exciting lesion, titubation is stated to be characteristic of lesions situated in the opposite direction in extra-cerebellar lesions, so that the sense of rotation of the body was in the opposite direction to that in which the external objects seemed to be moving. When the sense of rotation was accompanied by actual displacement of the body, the patient tended to rotate towards the side of the disease in extra-cerebellar disease and away from it in intra-cerebellar disease. This agrees with the observations of Adler and Guye that in unilateral disease of the labyrinth, there is vertigo with a feeling of movement towards the affected side. They also found that when the head was turned towards the affected labyrinth, a revolving vertigo occurred in which objects turned in the same direction, a condition which did not obtain when movement was made towards the sound side, whereas Stewart and Holmes found that vertigo and the sense of rotation in cerebellar disease is less when the patient is rotated towards the affected side than when rotated from it.

Abscess of the Temporal Lobe.

BLAU (*Archives of Otology*, Vol. XXXIV., No. 6). A boy aged 18 had a chronic, fetid discharge from the right ear. The lower half of the Mt. was gone. The malleus was carious and had lost its long process. Graulations filled the tympanum; these were removed but promptly recurred. The ossicles were removed, but the condition was unimproved. On a radical operation being done, the antrum was found filled with pus and granulation tissue and its bony walls and the tegmen carious and soft. The dura appeared to be normal, but showed no pulsation. For five days healing took a normal course, then there were complaints of pain and pressure in the right temple and eye. Three days later vomiting set in, he became restless, then comatose. Left sided muscular twitching; pulse, 140-160. Both pupils dilated, but the right the more so. He speedily recovered consciousness and pupillary reaction to light returned, but the pulse was usually slow, 58-66. Temperature, 36.9° to 37.3° C. The exposed dura became more and more hyperemic and finally very much discolored. On freely incising it, 1½ ounces of yellowish-green pus was liberated. The pulse rose to 72 and the headache and lachrymation ceased. On the dressing being changed on the afternoon of the same day, 1 ounce more of pus was evacuated. As the discharge still persisted, one month later the wound was extended backward and the dura further exposed for an area the size of half a dollar. This large opening allowed the softened brain substance gradually to exfoliate and two months later the wound had closed and the patient was apparently in perfect health.

Campbell.

Abscess of the Brain, with a Report of Five Cases.

HENRY FARNUM STOLL (*American Journal of the Medical Sciences*, February, 1906). The first case was one following trauma of the head in a boy of 10 years, who died previous to operation, and at the autopsy an abscess the size of an English walnut was discovered in the right half of the cerebrum.

The second case was one of metastasis of the left lung. Autopsy. In the middle convolution of the left frontal lobe was an abscess 5 cm. by 3 cm. in size. The pus was very fetid, but cultures made from it were sterile.

Case three, aged 24 years, acute otitis media. Operation performed; abscess not found. At the autopsy pus was found in the left parietal lobe, just posterior to the Rolandic fissure, and communicated with the left lateral ventricle.

Case four, followed chronic otitis media. Operated upon. Large abscess evacuated in the temporosphenoidal lobe. Death seven hours afterwards.

Case five, followed chronic otitis media after scarlet fever. Operation. By trephining three-fourths of an inch above the external auditory meatus, grooved director passed downwards, forwards and inwards; two to three ounces of pus evacuated. Cavity enlarged, irrigated with saline solution, rubber drainage tube introduced. Recovery.

The mortality from brain abscess still continues very high.
Richards.

Nature and Aim of Objective Measurement of Hearing, and on the Use of the Objective Audiometer.

OSTMANN (*Archives of Otolaryngology*, Vol. XXXIV., No. 4). The author's method of testing the vibratory amplitudes of tuning forks is to fasten them into a vise which is imbedded in a stone wall. The microscope with which the vibrations are measured is placed on an iron plate, likewise imbedded in the wall. Dry flour is strewn on the end of one of the prongs and one of the granules nearest the edge is observed, the excursions being measured with the micrometer eye-piece.

In this way he succeeded with unclamped C and G Edelmänn forks from the great to the fourth octave in determining the dying-out curve to the cessation of sound for the normal ear, i. e., to the normal threshold value, so that for the entire duration, the amplitudes, so far as they were not measured with the microscope, could be calculated in intervals of seconds. This was accomplished by interpolation of the values lying between the measured altitudes, and by extrapolation of those parts of the curves of the higher forks whose amplitudes, owing to their minuteness of excursion, could not be measured at all.

Having determined the normal curves of the unclamped C and G forks from the moment of extreme vibration to their dying out for the normal ear, tables could easily be constructed showing the duration of vibrations in intervals of seconds, the time of dying out and the extent of the amplitude.

With these at hand an objective test is easily, rapidly and exactly carried out.
Campbell.

Traumatic Atresia of the Auditory Canal.

RUDOLPHY (*Archives of Otology*, Vol. XXXIV., No. 6). After referring to twelve cases of traumatic atresia of the ear canal, all that could be found in literature, he reports a case from his own practice, in which a man was kicked on the chin by a mule, which resulted in compound fracture of the inferior maxilla and injury to both ear canals.

Examination soon after receipt of the injury revealed a swelling on the floor of the right meatus 4 mm. from the Mt. from which blood was exuding. Four weeks later considerable scar tissue had formed so that a small slit along the upper and posterior wall was all that was left of the lumen of the canal. The lumen continued to grow smaller and hearing was reduced to almost total deafness. The sound-perceiving apparatus was apparently unaffected, a fracture of the anterior wall of the auditory canal had evidently resulted in this case and the cartilaginous canal was torn from its bony attachment.

This case demonstrates the advisability in such accidents of endeavoring to prevent atresia by immediately replacing displaced fragments of bone and keeping them in position with a firm cotton tampon.

To relieve this condition an incision is made behind the auricle, the cartilaginous canal is severed from its surroundings and any osseous constriction removed by hammer and chisel.

Campbell.

Secondary Anesthesia—Hemiplegia as a Complication of the Mastoid Operation.

HARLAND (*Archives of Otology*, Vol. XXXIV., No. 5). A schoolboy aged 8 was operated upon for abscess of the left mastoid. After operation it was noticed that there was considerable loss of power in the left arm and leg, together with some paralysis (?) about the mouth and face. Heart, eye-grounds and muscles were normal. Mental condition good. Urinary examination revealed a moderate amount of albumin with hyaline and granular casts. The measurements of the limbs on the left side show them to be smaller than those on the right. All tendon reflexes in the left upper and lower limbs are increased. This then shows a hemiplegia of long duration and such atrophy could not have occurred in the short time elapsed since operation. Ever since an attack of

scarlet fever at the age of 5; the boy screws up his mouth and twists it as he talks. The boy was placed under a general anaesthetic at two subsequent times and each time the hemiplegia temporarily increased.

The boy can now run and use his arms for ordinary purposes, but there is still much awkwardness.

Various theories are advanced for the causation of this hemiplegia, but none appear to the abstractor to be satisfactory.

Campbell.

Communications Between the Blood-Vessels in the Membranous Labyrinth and the Endosteum and Those in the Bony Capsule of the Labyrinth.

SHAMBAUGH (*Archives of Otology*, Vol. XXXIV., No. 6). The author found that in making celloidin casts of the labyrinth in which the capsule was still cartilage, it was not necessary to remove the capsule at all, since the whole preparation would clear up perfectly in creosote. It was also found that where ossification was but partially advanced, the whole preparation was sufficiently clear, so as to permit of the study of the blood-vessels as they penetrated the region of beginning ossification. The embryo calf 20 cm. to 30 cm. in length was used.

By working with this method, communications between the blood-vessels in the membranous labyrinth and those in the capsule could be demonstrated at certain definite points, in the several dozen preparations studied. A characteristic of these communicating branches is that they always consist of a single large vessel which enters the capsule alone, and it is often accompanied by a vein which returns the blood from the capsule to the labyrinth. The points at which such communications were found are then given in detail.

Campbell.

Report of a Case of Infective Sigmoid Sinus Thrombosis and Jugular Vein Infection of Otitic Origin, Without Apparent Mastoid Involvement, in an Adult.

J. L. RICHARDS (*New York Medical Journal*, Dec. 16, 1905). The patient was a man of nineteen who had suffered recently from an acute suppurative otitis, which had healed without incision in the drum membrane. Five days later, a complete facial paralysis developed; seen on the fourteenth day, outside of the paralysis, there were no local signs of ear trouble. Tem-

perature and pulse were normal. Paracentesis was performed. On the following day a severe chill occurred with elevation of temperature. A mastoid operation was made which revealed only a few granulations. The sigmoid sinus was then exposed. A patch of purulent pachymeningitis was found over the sinus. The vein was opened chiefly upon "symptoms" and a thrombus was found. Four days after the operation, the temperature rose to 104 with a slight chill, and the internal jugular vein was ligated. The walls of the vein were found to contain streptococci. The paralysis gradually disappeared and the further history of the case was uneventful. The chief point of interest upon which the writer lays emphasis, is the apparent healthy condition of the mastoid itself.

Indications for Opening the Mastoid in Acute Suppurative Otitis Media.

THEODORE HEIMAN (*Annales des Mal. de l'oreille*, March, 1905). The general principles of surgery are applicable here as elsewhere. The persistence of inflammatory symptoms in the mastoid for eight or ten days does not necessarily call for operation—spontaneous cure may supervene. Opening the mastoid before the fifteenth day is rarely indicated, and never early. Before trepanation, antiphlogistic treatment should be tried; paracentesis should be done and the perforation should be enlarged several times if necessary. The operation should not become a measure to save life, but rather one of cure. Indications for operation are: Pain in the mastoid, not due to defective drainage, persisting after two or three weeks; abundant creamy pus prolonged for a month; sensitiveness of the tip; fever, especially after two or three weeks; general weakness, mental depression and gastro-intestinal troubles; meningeal irritation after free drainage is established. Wilde's incision is rarely sufficient to cure. In the main Heiman's views are conservative.

Cerebellar Abscess and Sinus Thrombosis.

Voss (*Archives of Otology*, Vol. XXXIV., No. 6). A man aged 31, who had received a blow on the right ear ten years previously, complained suddenly of severe pain on the right side of the head. He vomited several times. There were convulsive movements and weakness of the lower extremity.

From the right ear there was a fetid discharge. Temperature, 37° C.; pulse, 64.

The radical mastoid operation was undertaken and the antrum found filled with cholesteatoma. For four days after the operation his condition apparently improved, then some edema of the right upper eyelid was noticed and two days later pains on the right side of the head returned. Vomiting became more frequent, optic neuritis and swelling of the optic disc were found. The mastoid wound was reopened and the sinus found thrombosed. Incision of the cerebellum liberated one ounce of thick, fetid pus. A counter opening was made posteriorly to the sinus and the cavity tamponed. From this time on recovery was uneventful. *Campbell.*

The Ear Complications of Cerebrospinal Meningitis.

CHRISTOPHER J. COLLES (*Medical Record*, September 9, 1905). The causative factor of those cases of profound and lasting deafness which occasionally follow cerebrospinal meningitis is probably due to an inflammatory condition of the labyrinth. The infection probably spreads along the extralabyrinthine intracranial spaces to the endolymphatic and perilymphatic spaces of the labyrinth. The composition of the perilymph and endolymph undergoes a change, due to the presence of the specific germ, the blood vessels become dilated, and true tissue-hypertrophy takes place. The tissues become dense, bone thickening takes place, and often the semicircular canals or cochlea are partially, if not completely, obliterated.

Deafness when it occurs is almost invariably bilateral and it is permanent, the outlook for recovery of the hearing power being very grave and treatment unsatisfactory.

Richards.

Some Displeasing Results of the Mastoid Operation.

J. A. STUCKY (*New York Medical Journal*, Feb. 10, 1906). After commenting upon the great advance in mastoid surgery, Stucky refers to certain unpleasant results which may follow this operation. Among these, he emphasizes the necessity in many cases for a secondary operation, the occasional narrowing of the osseo-cartilaginous canal and granulations in the attic causing atresia of the auditory canal. This, in the opinion of Murphy, is due to faulty packing of the cavity. In 128 cases operated on by the writer, 40 per cent showed some external

evidences of pus. These cases resulted in ugly scars; in addition to these, certain disagreeable results, such as permanent unhealed sinuses, are referred to.

In conclusion, the writer lays stress upon the importance of a thorough preparation of the patient before operation, especially the removal from the system of any possible causes for intestinal fermentation.

A Plea for Routine Examination of the Middle Ear.

E. DANZIGER (*New York Medical Journal*, Nov. 18, 1905). There were 6,000 school children examined in Stuttgart, up to the age of seven: 23 per cent were afflicted with ear trouble. This illustrates the frequency with which affections of that organ are found in children. The close relation of the pharynx to the ear is, the author believes, an explanation of such frequency, but also refers to the intimate relation between the middle ear and intestinal disturbances, and believes that under all conditions it is of the utmost importance to examine the ear in cases of persistent disturbances of the intestines. Fifty per cent of all cases of measles suffer from middle ear complications. In 90 per cent of all diseases of the middle ear, we find, the infection is pneumococcus. The writer believes that the ordinary symptoms of otitis media may be lacking, and urges an examination of the ear as the only means of not overlooking such otitis. He advocates early paracentesis and the dry cleansing as a routine procedure.

A Tropical Affection of the Ears.

MUELLER (*Archives of Otology*, Vol. XXXIV., No. 6). Twelve or more cases observed by the author seem to be peculiar to tropical regions. Insidiousness of onset and gradual loss of hearing are marked symptoms.

Solitary boggy swellings which later became organized were found on every wall of the external auditory canal except the superior, and varied considerably in size, the largest extending two-thirds across the lumen of the meatus. Subjective noises of various kinds were complained of. The skin over the growths was always more or less hyperemic. In every instance, spontaneous improvement was noticed with removal of the patient from the unfavorable environments.

It seems probable that a hyperemia of the labyrinth might coexist with the hyperemia of the meatus and thus account for the tinnitus. *Campbell.*

Vertigo of Aural Causation.

CLARENCE J. BLAKE, Boston, Mass. (*Boston Medical and Surgical Journal*, October 5, 1905). Vertigo of aural causation may be regarded primarily as a pressure symptom, which may be exerted upon the labyrinth by forces operating from without as a result of changes in the middle ear, or may be produced from within as in the case of hemorrhage into the labyrinth, the effect upon the semi-circular canals, or intralabyrinthine pressure thus produced depending as to its intensity and duration on the location and extent of the hemorrhagic invasion. Recurrent vertigo is the result of an excessive intralabyrinthine vessel dilatation, from suspense of vasomotor inhibition, of reflex origin, either alone or coupled with a persistent intralabyrinthine pressure, of either extrinsic or intrinsic origin. *Richards.*

Report of a Case of Double Mastoiditis with Extensive Involvement of the Zygomatic Cells.

BRANDEGEE (*Archives of Otology*, Vol. XXXIV., No. 5). An Italian boy, aged 15, had suffered from a severe attack of influenza for two weeks. Middle ear inflammation set in with rapid involvement of both mastoids. On operation streptococci in almost pure culture were found. There was a mild leucocytosis and a polynuclear percentage of 84.

The zygomatic cells were most extensively involved. The reporter was surprised at the rapidity of infection, but that is characteristic of influenza inflammation.

Five days after operation pneumonia, which involved both lungs, set in. This ran a mild course and resolution was complete in 16 days.

Perfect recovery ensued with unimpaired hearing.

Campbell.

Diagnosis and Treatment of Suppuration of the Labyrinth.

STANISLAUS VON STEIN (*Annales des Mal. de l'oreille*, January, 1905) describes several cases in minute detail and concludes: Total or partial necrosis of the labyrinth is always accompanied by disorders of co-ordination which are especially marked in jumping with closed eyes. By causing the

patient thus to walk and jump and by goniometric measurements, an absolute diagnosis may be made in early stages. Paralabyrinthitis, with or without facial palsy, shows no troubles of co-ordination. When these troubles are observed, perilabyrinthitis or endolabyrinthitis must be suspected. When there is necrosis or caries, the diseased bone should be removed, preferably by gradual morcellation, especially in the young and in involvement of the pyramidal apex. In simple suppuration the area should be opened up and dressed daily.

The Position of the Manubrium in the Normal Drum.

BRUNZLOW (*Archives of Otology*, Vol. XXXIV., No. 6). Believing that the zygomatic arch corresponds to the horizontal meridian of the erect skull, this was chosen as the landmark for measurements.

Of 300 drums examined, the angle of the manubrium with the horizontal meridian averaged on the left side 45° , while for the right side it was 51.6° .

While these observations appear to be unimportant for the recognition of pathological conditions, yet it is well to take in account the tendency for the left manubrium to incline toward the horizontal.

Campbell.

Pyocyaneus Infections of the Ear.

M. LERMOYER (*Annales des Mal. de l'oreille*, October, 1905). The bacillus pyocyaneus seems to produce two types of external otitis, that of Zaufal with a discharge of green pus, and that of Helman with formation of a croupous membrane. Both are characterized by atrocious pain. The bacillus also produces acute otitis media with a sero-sanguinolent discharge, and the formation of sub-epidermic, sanguineous bullae.

The author reports some recent observations confirming his previous opinion that the bacillus pyocyaneus has a special affinity for cartilage, and is often responsible for perichondritis of the auricle and canal.

Route to the Cavernous Sinus.

H. LUC (*Annales des Mal. de l'oreille*, June, 1905) recently saw two cases of thrombo-phlebitis of the cavernous sinus which inspired him to work on the cadaver with a view to finding a feasible surgical operation for the relief of this

condition. He has arrived at the following theoretical procedure:

Free opening through the anterior wall of the maxillary sinus; then through its nasal wall; then into the sphenoidal through its anterior wall; then through the lateral wall of the sphenoidal sinus. Krönlein's method of reaching the ophthalmic vein may be added to this.

Anomalies of the Temporal Bone.

EMIL AMBERG (*The Journal of the American Medical Association*, June 3, 1905). As the result of measurements of seventeen temporal bones, in which the distance of the most protruding part of the lateral sinus from the suprameatal spine varied from 21 mm. to 6 mm., Amberg concludes that the lateral sinus which comes nearer to the suprameatal spine than 10.6 mm. can be regarded as displaced forward.

In one of his specimens, instead of the usual linea temporalis, there was a pronounced crest extending to the height of $4\frac{1}{2}$ mm. and apparently not having been produced by any pathologic changes.

Richards.

Recurring Facial Palsy and Alternating Facial Palsy of Otic Origin.

M. LANNOIS (*Annales des Mal. de l'oreille*, July, 1905) reports three cases. In the first case, the paralysis seemed to be caused by an acute catarrhal otitis, of which there were two attacks. Cure by conservative treatment. In the second case, there was paralysis of the right facial three years ago, and of the left facial in April, 1905, the latter accompanied by tinnitus, mastoid tenderness and other ear symptoms, but no discharge of pus. There was a history of lead-poisoning, which perhaps accounts for the right palsy. In the third case, there was a right facial palsy three years ago, and left palsy recently. The latter attack was accompanied by an acute catarrhal otitis.

Ossiculectomy Under Local Anesthesia for Suppurating Otitis Media.

MILTON J. BALLIN (*New York Medical Journal*, Feb. 17, 1906). A description of the method employed by Neumann for inducing local anesthesia of the middle ear and the technique pursued by him in the operation of ossiculectomy. The writer has followed this method in a number of cases with satisfactory results as regards the question of pain and bleed-

ing. He gives a brief account of the steps leading up to the present operation, as well as the indications for it, as stated by Politzer.

Technique of Operation for and After Treatment of Orogenous Cerebral Abscess.

HERMANN KNAPP (*Annales des Mal. de l'oreille*, January, 1905) first does the usual radical mastoid. He observes that by following up a fistula or other external sign, a cerebral abscess can be easily evacuated, but in order to effect a cure the focus of infection must be sought out and removed. In acute abscess, where the middle ear is not extensively affected, Knapp opens the mastoid, exposes the lateral sinus and examines the vicinity for necrotic bone foci, which are removed with the curette.

Mastoiditis in Infants.

SEYMOUR OPPENHEIMER (*Medical Record*, March 10, 1906). The pathological changes differ but little from those of the adult, but caries is more frequently found, the deeper structures being often damaged before the conditions are recognized, even the seventh nerve being involved, with resultant facial paresis or paralysis, or pus may break through the cortex with the formation of subperiosteal abscess.

While in the young child the mastoid cells are very imperfectly developed, the antrum is always present.

Richards.

Surgery of the Labyrinth.

JULIEN BOURGUET (*Annales des Mal. de l'oreille*, September, 1905) begins with a complimentary reference to Lermoyez's paper, read at the International Congress, describing the diagnostic points of suppuration in the labyrinth. Bourguet then takes up the subject of trepanation, and discusses the anatomy. He then details the technics of Jansen, of Hinsberg and of Botey. He finishes with a description of his own technique, introducing a new instrument, a facial nerve protector, which he uses in trepanning the external semi-circular canal.

Infective Arthritis Complicating Otitis Media.

EAGLETON (*Archives of Otology*, Vol. XXXIV., No. 6). Toxic arthritis may develop during the course of an otitis media suppurativa.

The ear is the most frequent source of general pneumococci

infection in children. Netler states that about 63 per cent originate from otitis media.

The character of the local lesion in a typical case is almost distinctive, the most striking feature being the nearly complete absence of circumarticular inflammation. *Campbell.*

Some Remarks Upon Otosclerosis, Apropos of an Autopsy Case.

JORGEN MOLLER (*Annales des Mal. de l'oreille*, March, 1905). The autopsy of this case inclines Moller to regard otosclerosis as an independent primary affection of the bone, and not to be classified with catarrhal troubles of the ear. In this case there were foci of osteitis in the neighborhood of the oval window and cochlea. The mucous membrane was nowhere affected, there being no adhesions or other evidence of any catarrhal condition.

Associated Otomycoses.

LOUIS BAR (*Annales des Mal. de l'oreille*, February, 1905). Many diffuse external otitides, of phlyctenular or vesiculopustular character, are either simple, or are complicated with dermatomycosis. The organisms include *aspergillus glaucus* and *niger*, *oidium albicans*, *mucor mucedo*, *tricothecium*, *trichophyton*, etc. The treatment consists in copious lavage with alkaline (4 per cent sodium bicarbonate) and antiseptic (bichloride 1-1000) solutions.

Thrombo-Phlebitis of the Jugular Bulb of Otic Origin—Treatment.

PAUL LAURENS (*Annales des Mal. de l'oreille*, August, 1905) discusses at length the anatomy, pathogenesis, pathologic anatomy, symptomatology, diagnosis and the different operative procedures. He finishes with the history of two cases in Lermoyez's clinic, one being operated by ligation of the jugular, opening of the sinus and lavage; the other operated by the transmastoid route. In the first case death resulted, in the second cure. As the cases were very similar, Laurens regards the transmastoid method as preferable.

Intracranial Section of the Auditory Nerve.

CHAVANNE and TROULLIEUR (*Annales des Mal. de l'oreille*, September, 1905) discuss this operation for the relief of tinnitus. After a study of the anatomy and experiments upon

the cadaver, they propose two routes, the preferable one being an entrance into the middle fossa. The authors have collated three cases, those of Lannois, Wallace and Marriage, and Parry. Of the three, only one survived, and she was not relieved, or at least would not admit it.

**Congenital Atrophy of the Right Auricle, with Imperforate Canal—
Hemiplegia of the Soft Palate on the Same Side and Atrophy
of the Fossa of Rosenmüller.**

P. CORNET (*Annales des Mal. de l'oreille*, July, 1905) reports this case in an Arab, aged 25. The atrophy of the auricle was extreme, it being represented by a small fold of skin, containing a bit of cartilage. A small depression marked the normal site of the canal. Hearing by bone conduction indicated a normal labyrinth.

A Simple Method of Dressing Mastoid Cases.

GEORGES MAHU (*Annales des Mal. de l'oreille*, July, 1905), inspired by Eeman's method of suturing the posterior lips of the mastoid wound and insufflating boric acid instead of packing, reports upon some cases which he dressed similarly except that he used no insufflation and simply tucked a bit of gauze into the meatus. He finds it applicable only where there is an otitis, but not where there is a cholesteatoma or tuberculosis.

**On the Disadvantages of the Dry-Gauze Dressing after the Operation
for Septic Thrombosis of the Lateral Sinus.**

GIFFORD (*Archives of Otolaryngology*, Vol. XXXIV., No. 4). The writer decries the use of dry iodoform gauze and instead of using a moist gauze such as is usually employed, wets his iodoform gauze in corrosive sublimate solution 1:1000 and covers the operative field and dressings with gutta-purcha tissue.
Campbell.

Contribution to the Pathologic Anatomy of Mastoiditis.

E. LOMBARD (*Annales des Mal. de l'oreille*, March, 1905) shows that meningitis coming on after mastoid operations is sometimes due to aberrant infected cells which were not cleared out. Such cells frequently exist between the antrum and the pyramidal apex, in the neighborhood of the facial canal. They are usually small.

Double Mastoiditis with Cerebral Symptoms in the Course of Puerperal Infection—Cure without Operation.

H. MASSIER (*Annales des Mal. de l'oreille*, March, 1905). The patient was accouched February 11th, and developed puerperal infection a week after. The ear troubles came on March 28th. Streptococci found in the pus. Paracentesis; ice to mastoids. Apparent cure in one month, but patient becomes dizzy if ears are not kept stopped with cotton.

Suppuration of the Labyrinth.

FERD. KLUG (*Annales des Mal. de l'oreille*, February, 1905) reports six cases. Scarletina was the cause in the majority. The state of audition could not be accurately determined, as the patients were mostly children. Paralysis of the facial was found in three cases. In only two cases was disordered equilibration found. Klug favors Jansen's operation.

Hernia of the Tympanic Cavity.

A. DE LINS (*Annales des Mal. de l'oreille*, March, 1905) reports two cases, and calls attention to the possibility of mistaking the projecting pouch of mucous membrane for a polyp. They are probably produced by the pressure of pus retained in the accessory cavities, thus pushing a sac of mucous membrane into the tympanic cavity.

Diagnosis of Syphilis by the Otologists.

ROZIER (*Annales des Mal. de l'oreille*, March, 1905) reports two cases of secondary syphilis, in which there was marked diminution of bone conduction, and he was thus led to a diagnosis.

II.—NOSE.**Description of Killian's Frontal Sinus Operation.**

E. E. FOSTER (*Boston Medical and Surgical Journal*, January 25, 1906). During the anesthetization, the nasal cavity of the affected side is filled with four tampons made of cotton, rolled into the shape of a small cigar, with a thread fastened about the middle. The first is firmly placed along the floor of the nose; the second in the middle meatus; the third in the

olfactory cleft, and the last beneath the bridge and between the frontal process of the maxillary bone and the septum.

The eyebrow is not shaved. There are three distinct incisions—first through the skin; second through the subcutaneous tissues to the periosteum, and third through the periosteum. The first begins at the temporal end of the eyebrow and extends inward through its middle to the nasal end, where it passes downward with a graceful curve along the root and side of the nose to and a little below the base of the nasal bone. Four or five short, superficial incisions are made at right angles to the long one, so that the approximation of the edges shall be accurate at the close of the operation. The eye is covered with a gauze pad. The edges of the wound being slightly separated with retractors, two incisions are made through the periosteum. The first begins at the temporal end of the original incision, extends inward 6 to 8 mm. above and parallel to the supraorbital margin, to the upper end of the nasal bones. The second begins one-quarter of an inch internal to the supraorbital notch and extends inward on the orbital margin until it intersects the nasal portion of the skin incision, which it follows to its lower end. The periosteum covering the anterior wall of the frontal sinus is elevated and retracted. If the outlines of the frontal sinus have previously been determined by skiagraphy, the groove forming the upper margin of the supraorbital bridge, can be made; otherwise an opening must be made into the sinus for the purpose of finding out with a probe its size and shape. The root of the nasal bone is the best place to make this opening. It should be made through the bone with the chisel, exposing but not perforating the underlying mucous membrane. The probe can then be passed between the bone and the mucous membrane, outward, upward and inward, giving information as to the approximate size of the anterior wall. The temporal end of the sinus is then marked off and a groove made from this point extending inward nearly to the median line, close to or a little below the edge of the periosteum covering the supraorbital ridge, that is, 5 to 7 mm. above the supraorbital margin, the object being to leave the bridge completely covered with periosteum. The lower part of this groove forms the upper edge of the supraorbital bridge and should be smoothly and evenly made. As soon as the groove is made deep enough to enter the sinus, all of the anterior wall of the sinus lying above can be removed

with bone forceps or chisel, care being taken not to break the bridge during the resection. The anterior wall being removed, the mucous membrane and any partial bony septa are carefully and completely erased, and all sharp corners, grooves or depressions obliterated so as to leave a smooth surface where no pus can be retained. The sinus is loosely filled with gauze and the retracted tissues allowed to assume their normal position.

The periosteum is next elevated and retracted from the nasal bone, the frontal process, lachrymal groove and orbital portion of the frontal bone, toward, but not to, the supraorbital notch. The chisel is placed at the lower end of the suture between the nasal bone and the frontal process of the superior maxilla and driven upward with a mallet along this suture, forming a groove, which groove is extended from the upper end of the suture into the frontal bone, toward but not to, a point midway between the supraorbital notch and the attachment of the trochlea, thus forming the lower edge of the supraorbital bridge. The chisel is again placed at the lower end of the suture as above, but this time it is driven at right angles to the suture, that is, through the frontal process toward the lachrymal bone, care being used not to injure the lachrymal sac. This groove prevents the downward breaking of the frontal process during its resection and is best accomplished by starting at the lowest portion of the frontal process to be removed. The bone is thinnest here and can be easily perforated without injuring the underlying mucous membrane, which is to be preserved for use as a flap. With the bone forceps the largest part of the process is now removed. At the upper end a chisel may be needed. The resection is extended a little way above the frontal process, including a small part of the frontal bone, which is a part of the sinus floor. The removal of this bony area gives free access to the floor of the sinus and the nasal cavity. The periosteum is now elevated from the remaining lachrymal bone and groove, from the orbital portion of the ethmoid bone posteriorly to the anterior ethmoidal vessels, and from the orbital portion of the frontal bone lying inward and downward to the trochlea attachment and supraorbital notch, the limits for elevation and resection being the lower part of the lachrymal groove below, the anterior ethmoidal vessels behind, and the trochlea attachment and supraorbital notch above. The orbital tissues are now re-

tracted outward and held in place by an assistant. The remaining sinus floor is then removed with part of the ethmoid plate and lachrymal bone and as many of the ethmoid cells as is found necessary, and even the opening of the sphenoid cell if it is diseased.

The surface of the whole bony field is made perfectly smooth and the operation completed, by making a flap of the uninjured mucous membrane that covered the resected part of the frontal process of the maxillary bone, and any adjoining healthy mucous membrane. This flap is pushed outward against the adjoining orbital tissues.

The wound is cleaned with normal salt solution and dried, and the whole area carefully examined for projections, nooks and corners which could in any way prevent perfect drainage. A narrow strip of iodoform gauze is loosely placed in the region of the ethmoid cells, an end of which hangs out of the nasal orifice. The remaining part of the nasal cavity is filled with cotton tampons. The tampons and gauze are removed on the second day and not renewed. The skin in the field of operation is cleaned, and the wound edges immediately sewed together with aluminum-bronze wire, unless there be a question of intracranial suppuration or the pus is very foul, or there exists decided necrotic process. In these conditions, the secretion is virulent and ought not to be enclosed in the sutured wound. Suturing is then left until the second or third day. About 80 per cent of the cases are immediately sutured. One per cent solution of atropin is instilled into the eye, the eye is then loosely covered with gauze and a good-sized dressing of moist boric acid gauze placed over all. The patient is put in bed on the sound side, made to lie in this position most of the time for a few days, and is forbidden to blow the nose and told to draw into the throat all wound and nose secretion. The dressings are changed daily and on the fourth or fifth day the sutures are removed. A day or so later the eye is left uncovered. The nasal cavity is not flushed out nor is there much intranasal treatment. At the end of the third or fourth week the wound cavity lying above the mucous-covered nasal cavity is painted with a $2\frac{1}{2}$ per cent solution nitrate of silver.

Richards.

Pathogenesis of Maxillary Empyema.

GEORGES MAHU (*Annales des Mal. de l'oreille*, August, 1905) reports upon 100 maxillary sinuses examined post-mortem, in which he found eight diseased as follows:

Four maxillary sinusites of nasal origin.

Three maxillary empyemas of dental origin.

One parulis in the sinusal floor.

He suggests that the following is the mechanism in infection from teeth:

1. Caries of extreme degree (i. e., extending into the root).
2. Apical abscess of a root of the tooth (preferably an antero-external one).
3. Perforation of the floor of the sinus. Penetration of the pus into the antrum, lifting but not perforating the mucosa (closed parulis).
4. Perforation of the mucosa (open parulis, or maxillary empyema).

In none of the dental cases were there granulations or fungosities (so-called pyogenic membrane) on the sinus walls, such as exists in true chronic sinusitis, and Mahu endorses Lermoyez's view that maxillary empyema and chronic sinusitis should be kept distinct. He also calls attention to the resistance of the sinus mucosa to infection from pus of dental origin.

Mahu's report contradicts the accepted figures of 80% dental origin and 20% nasal origin, but he hopes to enlarge his statistics within a year.

Operations on the Accessory Nasal Sinuses.

JONATHAN WRIGHT (*New York Medical Journal*, October 7-14, 1905). As a result of his review of current literature, as well as his own experience, Wright is inclined to believe that too little attention in late years has been given to the intranasal approach to the accessory sinuses, and would limit the external method to operations on the frontal sinus. He speaks with particular favor of the method devised by Jansen for entering the various sinuses through the antrum. He takes a distinctively conservative position in regard to the necessity for radical operation, and feels that the vast majority of cases not operated on, sometimes after years of suffering, it is true, have got well themselves. He would divide all cases he regards as radical into two classes:

First, those patients who are fairly comfortable, with but little annoyance in the nose, no fever, and no pain except at intervals. Such cases he believes will be relieved by intranasal procedures (perhaps combined with the radical operation on the antrum of Highmore).

Second, those urgent, painful, suppurating, febrile cases where there can be no question of the demand for immediate operation. [Wright's position is quite in accord with that taken in a recent article by Hajek, who strongly condemns the overzeal on the part of many surgeons for the radical operations. —Abstractor.]

Chronic Empyema of the Antrum of Highmore.

G. A. LELAND (*Laryngoscope*, August, 1905). The writer's later experience has shown him that large numbers of the cases of chronic empyema of the maxillary sinus may be brought to a successful termination, without radical operation, by intranasal measures of treatment, and is convinced that by comparatively simple conservative measures, following out nature's laws and methods, large numbers of the cases of antral empyemata may be cured without radical surgical interference. "For though 'there is a divinity that shapes our ends, rough hew them how we may,' we do not believe that that divinity shaped our upper end to be unnecessarily rough hewn by every ambitious rhinologist, young or old, with a surgical bent, who may have observed in our large municipal or perhaps European clinics a bold, fascinating, almost reckless dexterity applied to the worst cases that can be found among the lowest classes of society, where the finer sensibilities are in abeyance, or where the victims, through fear of, or in gratitude to, their surgeon, do not magnify their post-operative discomforts, disregarding their lesser ills, because relieved of the greater; but this is rarely the case in private practice, and, for this reason, these conclusions have been drawn from the behavior of those in the higher walks of life."

He is opposed to permanent or temporary openings into the mouth.

Richards.

The Radical Operation for the Cure of Chronic Frontal Sinusitis.

THOMAS J. HARRIS (*Post-Graduate*, August, 1905). The ideal frontal sinus operation should allow thorough inspection of the entire sinus; free entrance to the anterior ethmoid cells

with complete exenteration; free drainage from the sinus into the nose; complete removal of all disease wherever found; be reasonably free from danger to life and from the risk of wounding neighboring organs, as the orbit; have an after-treatment relatively short, and be free from danger of recurrence and of serious disfiguration.

These conditions, he thinks, are in the main admirably met by the method recently advanced by Professor Killian, which is in effect a combination and elaboration of various methods, and acts on the principle that concomitant disease of the ethmoid is present as a rule, and so removes the frontal process of the superior maxilla in order to allow an uninterrupted approach to the disease there and its thorough removal.

Richards.

The Lymphatics of the Nose and Nasal Fossae.

MARC ANDRE (*Annales des Mal. de l'oreille*, May, 1905) has an extensive and nicely illustrated article. He shows that:

The lymphatics of the nose are tributary to the parotid, genial, sub-maxillary, sub-hyoid and deep cervical glands.

The lymphatics of the nasal fossae empty into the sub-tubal, pharyngeal, retro-lateral, retro-pharyngeal and deep cervical ganglia; from the base of the skull to the middle of the neck.

To be noted are:

The richness of the lymphatic network.

The presence of numerous free anastomoses in the median line joining the right and left sides.

Anastomoses between the cutaneous and mucous systems.

That the lymphatics of the nose and nasal fossae are not at all independent, but communicate freely with those of adjacent organs.

That, from a clinical point of view, the superior lymph collection of the nasal fossae empty into very inaccessible ganglia, and infection of the latter may be almost unnoticed.

Operation Indications in Certain Forms of Frontal Sinusitis.

E. LOMBARD (*Annales des Mal. de l'oreille*, June, 1905) gives a very long and complete discussion of the subject.

In acute suppurative frontal sinusitis, if virulent and grave, attempts at drainage by the nasal route should be attempted, but more radical operation may be required.

In non-exteriorized chronic suppurative sinusitis, the author

recognizes two forms: first, the sinusitis exulcerens et abcedens of Killian, in which radical operation is demanded; second, a milder form (Zuckerkindl's chronic catarrhal), when the question of operation is a mooted one. Lombard inclines to conservative measures.

Sinusitis with external fistulae or attended with complications should be operated.

Lombard discusses at length the various operations applicable.

The Various Routes to the Sphenoidal Sinus.

JULES LABOURE (*Annales des Mal. de l'oreille*, May, 1905). The sinus may be attacked:

1. Upon its lateral aspect by resection of the zygomatic arch. Long, complicated and dangerous.

2. Upon its inferior, or naso-pharyngeal, aspect. Scheech's operation. But the inferior surface is sometimes very thick. There is risk of going through the basilar.

3. Upon its anterior aspect. Under this head come the exceptional operations of Verneuil and Chalot, Chassaignac, Ollier, Lawrence, Rouge, Bardenhauer-Goris and Moure.

The orbito-ethmoidal route has been perfected by Kuhnt, Goris, Chipault, Laurens and Guisez.

The maxillary route, proposed by Jansen in 1892. It has been used by Luc and Furet.

The nasal route, which Labouré prefers, is described in detail.

Deflection of the Nasal Septum in Children.

ARTHUR A. BLISS (*American Medicine*, November 4, 1905). In the case of deflected septum due to injury, the author advocates prompt and careful examination of the child's nose and the giving of a general anesthetic if necessary. If the operator's little finger cannot be introduced into the narrowed nostril, and the septum pushed into place, a dressing forceps wrapped with sterile gauze, can be used to accomplish this result. A piece of rubber drainage tube, large enough to fit firmly into the naris, and cut about $1\frac{1}{2}$ in. to 2 in. in length, is then introduced. He cuts both ends of the tubing obliquely and inserts it into the nostril, so that the projecting point of the anterior end, coming forward over the triangular cartilage, will fit snugly up into the hollow at the extreme end of the nose, thus anchoring the tube in place.

Richards.

A Submucous Resection Operation for Deviation of the Nasal Septum; With the Description of Several New Instruments.

LEE M. HURD (*Medical Record*, November 25, 1905). Hurd has introduced two new instruments for the improvement of the technique of the submucous operation; the first consisting of a speculum with a long upper and a short lower blade, thereby rendering the aid of an assistant unnecessary. The long blade is passed between the membranes and the instrument is used with the long blade uppermost at all times. The instrument is not intended for use until the cartilage has been removed, which allows the entrance of the long blade.

For the removal of the bony crest or the anterior nasal spine, he has devised a stout cutting forceps, which can be used without fear of injuring the membrane. *Richards.*

Adenopathy in Affections of the Nasal Fossae and Rhino-Pharynx.

GEORGES GELLE (*Annales des Mal. de l'oreille*, July, 1906) discusses adenopathy in acute nasal infections, tuberculosis, lupus, syphilis and malignant tumors. In the first three, the sub-maxillary glands are often involved. Syphilis is usually accompanied by a so-called satellite gland enlargement. Küm-mel has called attention to the rarity of adenopathy in tumors of the nasal fossa. In tumors of the naso-pharynx the cervical glands are affected.

Case of Congenital Membranous Occlusion of the Choanae.

L. BELLIN and R. LEROUX (*Annales des Mal. de l'oreille*, August, 1905) describe this case in a male aged 24. The choanal arches posteriorly were well outlined, but about one centimeter in front was a membranous partition, complete on the left and with a small perforation on the right. Cure after several operations by M. Lermoyez and establishment of nasal respiration and olfaction, neither of which had previously existed.

The Conservative Treatment of Chronic Suppuration of the Frontal Sinus.

W. E. CASSELBERRY (*Laryngoscope*, August, 1905). Of sixteen cases treated conservatively, that is, by nasal methods, six were of a mild type and those were cured. Of the remaining ten typically severe cases, only one was cured, two were much improved, three were somewhat improved, and four were unbenefited. *Richards.*

Chloroforming and Rhinology.

J. TOUBERT (*Annales des Mal. de l'oreille*, September, 1905) has devised an apparatus by which chloroforming can be mixed with more or less air as desired. He uses a bicycle pump and a funnel ending in a rubber tube, which is introduced through the nose and deep into the pharynx. He cites several cases showing good results.

Osteomyelitis of the Superior Maxilla with Ethmoiditis and Empyema of the Sinus.

LUBET-BARBON and F. FURET (*Annales des Mal. de l'oreille*, September, 1905) report this case in a girl, aged 15: The empyema was believed at first to be due to a true sinusitis, but after several operations, areas of necrotic bone were found from which the pus undoubtedly came. The case is not yet cured, but is progressing rather favorably.

Reflections upon the Surgical Cure of Chronic Frontal Sinusitis.

PIERRE SEBILEAU (*Annales des Mal. de l'oreille*, January, 1905) discusses the Ogston-Luc, Kuhnt and Tilly operations, and describes his own variation of them, which is a resection of the anterior sinus wall and free enlargement of the nasofrontal canal. He uses no drain.

Necrosis of the Superior Maxilla from Phosphorus Poisoning—Operation—Cure.

J. N. ROY (*Annales des Mal. de l'oreille*, July, 1905) reports a case in a woman of 36, a matchworker. The alveolar process was necrotic. The sequestra were removed and the patient recovered.

III.—MOUTH AND PHARYNX.**The Results of Treatment of Cancer in and about the Mouth at the Boston City Hospital.**

HOWARD A. LOTHROP and DAVID D. SCANNELL (*Boston Medical and Surgical Journal*, April 13, 1905). The cases reported upon were taken from the records of the Boston City Hospital during the nine years from 1895 to 1903 and are 60 in number. Of these there are now living 4, and 56 are dead. The number operated on was 43; the number not operated on 17. The average duration of symptoms up to

the time of first observation was $7\frac{1}{2}$ months; the average duration of life after first observation, whether operated or not, 9 months; average duration of life from time of first symptoms, 16 months; average duration in those not operated, 6 months; average duration in those operated, $9\frac{1}{2}$ months.

In cancer of the tongue the operated cases lived twice as long as the non-operated cases.

In cancer of the inferior maxilla, operated cases lived four times as long as non-operated.

Effect of complete or partial excision as lengthening life: Tongue, partially excised cases lived over three times as long as those having complete excision.

Inferior maxilla: complete excision cases lived over twice as long as those palliated.

Superior maxilla: complete excision slightly more than doubled the duration of post-operative life.

Tonsil and fauces: radical treatment resulted in a doubled length of life after operation.

Of 30 cases, 5 were made worse, 3 no better than before operation, 20 temporarily benefited, and 2 cured.

As all unoperated cases die sooner or later of the disease, barring intercurrent affections, and as the duration of life of operated cases as compared with those not operated was in favor of the former by an average of about three and one-half months, the authors believe that if early diagnosis of malignant disease about the buccal cavity can be made, that moderately radical excision of the parts offers the greatest hope of a radical cure, commensurate with the comfort of the patient and the immediate risk to life. If there is extensive invasion of the parts, excision, if done at all, should be done solely with the idea of palliation, without too serious interference with physiological function and without too great immediate risk.

Richards.

Gangrene of the Tonsil.

CHARLES W. RICHARDSON (*American Journal of the Medical Sciences*, October, 1905). This condition is extremely rare, the author having been able to find but three cases in medical literature, abstracts of which are a part of his paper.

His own first case is a man 45 years of age, with, at first,

marked signs of quinsy, followed by pus discharge and subsidence of the swelling, and two days thereafter by white spots on the right tonsil. At first it was thought to be diphtheria, but later the tonsil broke down into one continuous mass of grayish, brownish, putty-like slough, which was the condition when seen by the author on the tenth day of the disease. The opposite tonsil was normal. The patient was in extremis and died two hours after. Antitoxin had been given without any result.

The second case was a man 36 years of age, with a history of sore mouth and throat for several days. At first improvement, followed a few days later by a dirty, grayish-looking patch in the left tonsil, looking at first like diphtheria, but a culture was negative. When seen by the author the temperature was 100.1-5. The buccal cavity seemed normal, with the exception of the right tonsil, the whole surface of which was covered with a blackish, scab-like exudate, with an exceedingly offensive odor. This was subjected to a most vigorous curetting without being able to reach healthy tissue. The tissue removed seemed to be necrotic. Diagnosis of dry gangrene of the tonsil made. The day following it was again curetted and smears taken showing the presence of a diplococcus resembling the *D. lanceolatus*.

Staphylococci were fairly abundant. Tubercle bacilli and spirillae were absent. Ten days later the patient died from exhaustion.

Richards.

Observations on One Thousand Adenoid Operations.

FRANK B. SPRAGUE (*The Providence Medical Journal*, March, 1906). Five hundred and three of these were male and 497 were females, and ranged in age limit from 6 months to 37 years. Thirty per cent were during the first seven years; 50 per cent during the second seven years, and 20 per cent during the third period of seven years. In 905 cases or about 90 per cent, the adenoids were associated with hypertrophy of the faucial tonsil.

Investigation as to etiology did not lead to very satisfactory results. The author regards the condition as an excessive activity of the lymphoid tissue of the pharynx, at first normal, stimulated by constant irritation from particles of dust or secretions with mild infection; the rapidity and development being

governed by the atmospheric, climatic and constitutional conditions and of personal hygiene.

There was only one case of true recurrence, and here the amount of the tissue was very slight. He does not regard recurrence as likely to occur if the primary operation is thoroughly done.

Richards.

Urano-Staphylorrhaphy.

OWEN SMITH (*Transactions Maine Medical Association*, 1905). The author has modified the Brophy operation for cleft palate by having silver wires drawn out in such a way that one end remained the size of the original wire while the remaining part was reduced to the size desired for the convenience of manipulation. On the larger end of the wire thus drawn he had threads cut (100 to the inch) and a nut fitted. After this wire is in place, all that is necessary to do is to give the nut a few turns from time to time as the parts are moulded into position, taking up, as it were, the slack in the wires. The method of introduction is the same as used by Dr. Brophy in his operation. Up to the age of three or four years he thinks a deformed face can be brought into almost perfect position.

Richards.

Three Cases of Polypi of the Tonsil.

S. BONNAMOUR (*Annales des Mal. de l'oreille*, October, 1905). The first case was notable for the large size of the polyp which was attached to the left tonsil. It measured 3 by 1 c. m. The polypi were single in the other two cases and were of considerable size, but not as large as in the first case.

Bucco-Pharyngeal Syphilis—Multiple and Successive Chancres.

TEXIER and MALHERBE (*Annales des Mal. de l'oreille*, October, 1905) report the case of a 17-year-old boy who had a chancre on each tonsil and five days later developed a third chancre on the upper lip.

A Case of Chancre of the Tonsil.

JOANNOVICH (*Annales des Mal. de l'oreille*, March, 1905). The lesion was in the upper pole of the left tonsil, was indurated, was accompanied by lymphatic enlargement, and produced prolonged dysphagia. Patient was a male, 22.

IV.—LARYNX.

Thyrotomy vs. Laryngectomy—Notes on the Frequently Malign Nature of Chronic Hoarseness.

CHEVALIER JACKSON (*Medical News*, December 9, 1905) reports two cases which show the necessity for early diagnosis in cases of chronic hoarseness and the frequently malign nature if it. He urges that the operation of thyrotomy be done as soon as the diagnosis of malignant disease is made, thereby saving not only the life, but the voice, comfort, happiness and usefulness of the patient. Whereas, when the diagnosis is made late, although total or partial laryngectomy will prolong life for a variable period, recurrence is pretty certain and the extension of existence is accompanied by many discomforts.

The early curable stages of laryngeal cancer are characterized by nothing but hoarseness, which may disappear and recur. Whereas the more positive symptoms of cough, odor, pain, odynphagia, glandular involvement, external swelling, emaciation, cachexia, etc., are present only when the curable stage is past.

Dr. Jackson regards the surgery of malignant disease in the larynx as discouraging only when the case is seen late. He thinks that in early thyrotomized cases the prognosis as to cure is better than it is in chronic laryngitis.

In case 1, the patient came for chronic hoarseness, and on examination a small epithelium about the size of a pea was found on the right cord. Immediate thyrotomy was urged, but declined by the patient, who spent three months of time in getting opinions and treatment from irregular practitioners. Operation was then performed, but what had been intrinsic epithelioma had become extrinsic by extension, so that total laryngectomy was required. The whispered voice was obtained, but eight months later there was recurrence with metastasis and death.

In case 2 the patient, 37 years of age, complained only of hoarseness. Examination showed a small epithelioma of the squamous-celled variety, on the under surface of the right cord. A thyrotomy was done, the thyroid cartilage split in the median line, the growth, with a wide area of surrounding healthy tissue, including the entire right vocal cord, was clipped out. The wound healed in ten days, and now, after four years, the voice is practically perfect, not only for speaking, but for simple song of limited range.

Richards.

Papilloma of the Larynx in Children.

J. PAYSON CLARK (*Boston Medical and Surgical Journal*, October 5, 1905). Of 12,623 children under fourteen years of age seen in the throat department of the Massachusetts General Hospital from 1889 to 1904, there were 12 cases of papilloma of the larynx, showing the affection to be quite rare in the United States.

The writer reports fourteen cases in detail, and as a result of his experience and a study of the literature, he regards thyrotomy for papilloma in children as unjustifiable. Of the fourteen cases reported, nine were boys and five were girls, and the ages varied from three months to eight years of age, the time elapsing between the appearance of the first symptoms and the application for treatment varying from four months to four years and nine months.

Treatment without tracheotomy was attempted in four cases. One died under the operation, one was lost sight of, one was successful and one after several successful operations required tracheotomy for a sudden attack of dyspnea during an operation. Preliminary tracheotomy was done on the ten remaining cases. Of these, four died; three of bronchopneumonia, and one of sudden suffocation after a difficult second tracheotomy.

The two methods employed for seeing the papilloma were the indirect (laryngeal mirror) and the direct (Kirstein's auto-scope or Killian's tubes).

As a result of his own experience and reported experience of others, the writer says that in the future he will employ for these cases tracheotomy only and absolute non-interference with the growth, as in the cases where operative interference was resorted to, the growth returned with increased activity. As in the large majority of reported cases all attempts at removal have affected the growth unfavorably, he believes the best procedure to be to follow Mackenzie's rule to open the trachea in every case where complete permanent aphonia is present, as children can wear a tracheotomy tube with comfort and without interference to the health for years.

Richards.

**Pathologic Anatomy of a Case of Recurrent Laryngeal Paralysis—
New Theory as to the Cause of Muscle Changes, Especially
of the Posterior Crico-Arytenoid.**

JULES BROCKAERT (*Annales des Mal. de l'oreille*, February, 1905) advances a theory to explain the predominance of atrophic and degenerative changes in the posterior crico-arytenoid in recurrent nerve palsy. From his case he concludes that the same diseases which affect the recurrent laryngeal, in many cases lead to nutritive disorders in the posterior muscle, which is supplied with blood from the inferior thyroid artery and the inferior thyroid plexus. It is due to mechanical compression of the arteries by degenerated lymphatic masses, tuberculous, syphilitic or cancerous glands, and thyroid and aneurismal tumors. The other muscles are supplied by the superior laryngeal artery, which is not liable to compression by these tumors.

The Presence of Bacteria in the Larynx.

OTTOKAR FRANKENBERGER (*Annales des Mal. de l'oreille*, February, 1905) reports upon the examination of swabs and cultures from the ventricle of Morgagni of twelve healthy persons. He found:

Pneumococcus of Friedlander in.....	3 cases
Staphylococcus	3 cases
Streptococcus	3 cases
Bacillus pyocyaneus	1 case
Sarcina	1 case
Cladothrix alba	1 case
Micrococcus sulphuratus	1 case
Micrococcus rosens	1 case
Saccharomyces	2 cases

Observations on Four Cases of Total Laryngectomy.

PIERRE CAUZARD (*Annales des Mal. de l'oreille*, August, 1905). In the first case there was accidental death on the fifth day by the canula escaping, and by the efforts of the attendant to replace it, who pushed the canula through the posterior tracheal wall. Second case successful. Third case died with progressive necrosis of the tracheal rings. Fourth case successful after complications. Cauzard concludes that laryngectomy in two steps is preferable to that in one. He recom-

mends: (1) Section of the trachea; suture to skin. (2) Extirpation of the larynx; reformation of the pharyngo-esophageal canal.

Santonin in Laryngeal Crisis of Tabes.

COLLET (*Annales des Mal. de l'oreille*, September, 1905) relates the case of a woman, aged 51, having violent crises. After failure to relieve with other medicines, santonin, gr. 15, t. i. d., relieved the attacks. Santonin was continued two months, then stopped; crises recurred and were again checked with this drug.

V.—MISCELLANEOUS.

Pica. Report of a Case of Sugar Eater.

JACOB E. SCHADLE (*St. Paul Medical Journal*, November, 1905). The term "pica" means a morbid desire for unnatural or strange food. The patient in question presented the usual evidences of a healthy individual. The mucous membrane of the buccal and faucial cavities was dry, smooth and markedly red. The tongue was glossy, dry and red, and the post-nares and the larynx showed the same condition, the whole suggesting the characteristic local appearances of diabetes. The larynx was hyperesthetic, but the soft palate and pharynx were anesthetic. Local applications of chloride of zinc to the larynx were followed by relief. A peculiar characteristic of the case is that prior to twelve years ago the patient had an abnormal appetite for acids, and to gratify this desire indulged in the free use of lemons and sour pickles. At that time her weight was 165 pounds, which decreased in the course of a year's time to 105 pounds. Following an illness at this time, a ravenous appetite for sweets developed, which perverted function she indulged by eating large quantities of sugar. This habit gradually grew until nearly all natural food was excluded from the diet to the extent that she practically subsisted and depended on sugar. This practice has been kept up for twelve years without producing any apparent damage to the system, and the weight has gone up from 105 to 163 pounds. The craving has continued and at no time has she become tired of the sugar.

She has a special bowl which she fills on an average from six to eight times a day with granulated sugar. This vessel she empties just as many times each day by eating the sugar

with a teaspoon. No matter what her employment may be, the sugar bowl is always at her side, and while she works or is otherwise engaged, she eats. She is consuming on an average about four pounds daily or about three-fourths of a ton per year. During the menstrual epoch the craving for sugar is intensified, and on these occasions for a few days she ordinarily eats from six to eight pounds per day. Examination of the urine during the menstrual period showed albumin, negative; sugar, positive; specific gravity, 1025. Examination after menstruation, specific gravity, 1008; sugar, negative; albumin, negative.

She was taken off from a diet of sugar for two weeks, but her longing for sugar became voracious and practically intolerable, and she said she could not have endured it much longer, as she grew nervous, irritable, and crazed with a desire to satisfy her perverted appetite. The quantity of water drunk is considerable, yet there is no history of polyuria.

A number of other cases of perverted tastes, quoted from literature, are reported.

Richards.

Asthma.

SAMUEL KOHN (*Medical Record*, August, 26, 1905). The author has been able to find the reports of only three autopsies and in none of these was there anything characteristic. Thus far no change in the nerve centers has been discovered to which the disease can be positively attributed, hence we are driven to the hypothesis that there must be a molecular change in the nervous centers or a periodic disturbance in their vascular supply, and that the asthmatic attack is the culmination of a series of irritations transmitted to the nerve centers, which finally result in the explosion.

While he does not believe that the operative treatment of the nose for the cure of asthma can be of such widespread utility as its supporters originally claimed, he thinks that all asthmatic patients should have the upper air-tract carefully explored and cocaineized to note the effect upon the breathing and any abnormal conditions should be removed so far as possible. Asthmogenic areas should be looked for with a probe, and if found should be treated either by cauterization with chromic or trichloroacetic acid, or galvano-cautery, lightly applied. It must be borne in mind that the asthmatic is such not because of some abnormality in his nose, bronchi, or in some other organ, but because, at bottom, there is a derange-

ment of his entire nervous system. All the other functions of the body should be as carefully looked after for possible disorders as should the nose and upper air tract.

From a therapeutic standpoint he has found nothing so valuable as the iodide of potassium, beginning with one grain doses three times a day and increasing to from 25 to 30 grains a day where borne. It has been his experience in many cases of pure asthma or bronchial asthma that by this means the number and the severity of the attacks are markedly diminished, and that finally the patients remain entirely free from attacks. The iodine seems to stimulate the gland secretion and lower the arterial pressure.

Richards.

Hemorrhage in Nose and Throat Operations.

EMIL MAYER (*Laryngoscope*, September, 1905). In operations on the pharynx and naso-pharynx, suprarenal extract is inadvisable on account of the danger of secondary hemorrhage following the operation. A careful inquiry should always be made as regards bleeders, and such cases should not be operated upon by cutting methods.

In operating for lymphoid hypertrophies and tonsils combined, the posterior nares should be cleared out first, since if the tonsil be removed first the bleeding is so apt to obscure the field of operation that the lymphoid tissue is but partially removed, the operation being too hastily done.

Patients who have been operated upon under anesthesia in the posterior nares and pharynx should not be allowed to walk about immediately thereafter. The author insists that in operations done in public institutions the patients should remain over at least one night.

In all operations on the nose he puts in a packing in every case in order to avoid the possibility of subsequent hemorrhage. Over seventeen years of age he regards it as better surgery to operate on one tonsil and not do the other until after healing from the first has taken place.

Richards.

Eucaïn Lactate as an Anesthetic for Operations on the Nose and Throat.

T. J. HARRIS (*American Medicine*, December 30, 1905) has found eucaïn lactate to be an excellent substitute for cocaine; it can be employed in the strongest solutions without fear of toxic symptoms, and does not seem to lose its anesthetic qualities under the usual periods of office use. It is not, however, as

strong in anesthetic power as cocaine, and in the more painful operations must be used in correspondingly stronger solution, a 15% to 20% solution of eucain lactate corresponding to a 10% solution of cocaine.

For the submucous resection operation he uses the following formula: Eucain lactate, 8 gr.; sodium chloride, 21 gr.; boiling water, 14 drams; adrenalin chloride, 18 mm. Twenty to thirty minims of this solution injected at two or three points of the mucous membrane of the nasal septum produces satisfactory anesthesia.

Richards.

Legitimacy of the Distinction between Lupus and Tuberculosis of the Upper Air Passages.

E. ESCAT (*Annales des Mal. de l'oreille*, October, 1905) makes the following differential points: Lupus progresses slowly, descends from the nasal fossae, has multiple points of inoculation, is slow to invade bone, is serpiginous (healing and extending), forms scar tissue like syphilis, has no red aureolas about the lesions, secretes scantily, forming crusts, is indolent, dysphagia is the exception (the surfaces are rather anesthetic), cough is rare, the general health long remains good, heredity is exceptional, the lesions heal under treatment like they do on the skin.

Tuberculosis differs obviously in each of these particulars.

Foreign Bodies in the Bronchi.

THOMAS A. CLAYTOR (*American Medicine*, March 17, 1906). Fifty cases of foreign bodies of various kinds are here recorded, of which 38 recovered and 12 died. The death rate of 20 per cent, much less than that usually recorded, is probably attributable to the recent introduction of the bronchoscope. Of 33 patients operated upon, 28 recovered and 5 died, while of 17 not operated upon, 10 recovered and 7 died.

Richards.

Sterilizable Lamp for Diaphanoscopy (Transillumination).

E. LOMBARD (*Annales des Mal. de l'oreille*, July, 1905) has devised a removable and sterilized glass and metal cover for the bulb.

Foreign Bodies in the Bronchi and Bronchoscopy.

E. J. MOURE (*Revue hebdomadaire de Lary.* etc.) reports two cases of foreign body in the bronchus removed by bronchoscopy. The first was that of a man 63 years old, who suffered from pulmonary abscess due to two fragments of bone which enter the bronchi. An operation was made with the following steps: Incision of the skin muscles and thyroid body, perfect hemostasis by ligature of the veins and arteries, the opening of the trachea below the first ring, introduction of dilator with two blades permitting access to the tracheal canal; after cocainization the reflexes soon ceased. When the trachea and bronchi no longer reacted under the influence of the cocaine, Moure introduced the tracheascope and saw at a depth of 16.5 cm. a mass surrounded by pus. He removed the mass by means of the Killian forceps. A second piece was also removed. In the second case it was found impossible to do any good. Patient died, and on autopsy a fragment of bone of irregular triangular shape was found in the left bronchus a half centimeter from the tracheal spur.

